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OIL CONCESSIONS IN THE FAR EAST

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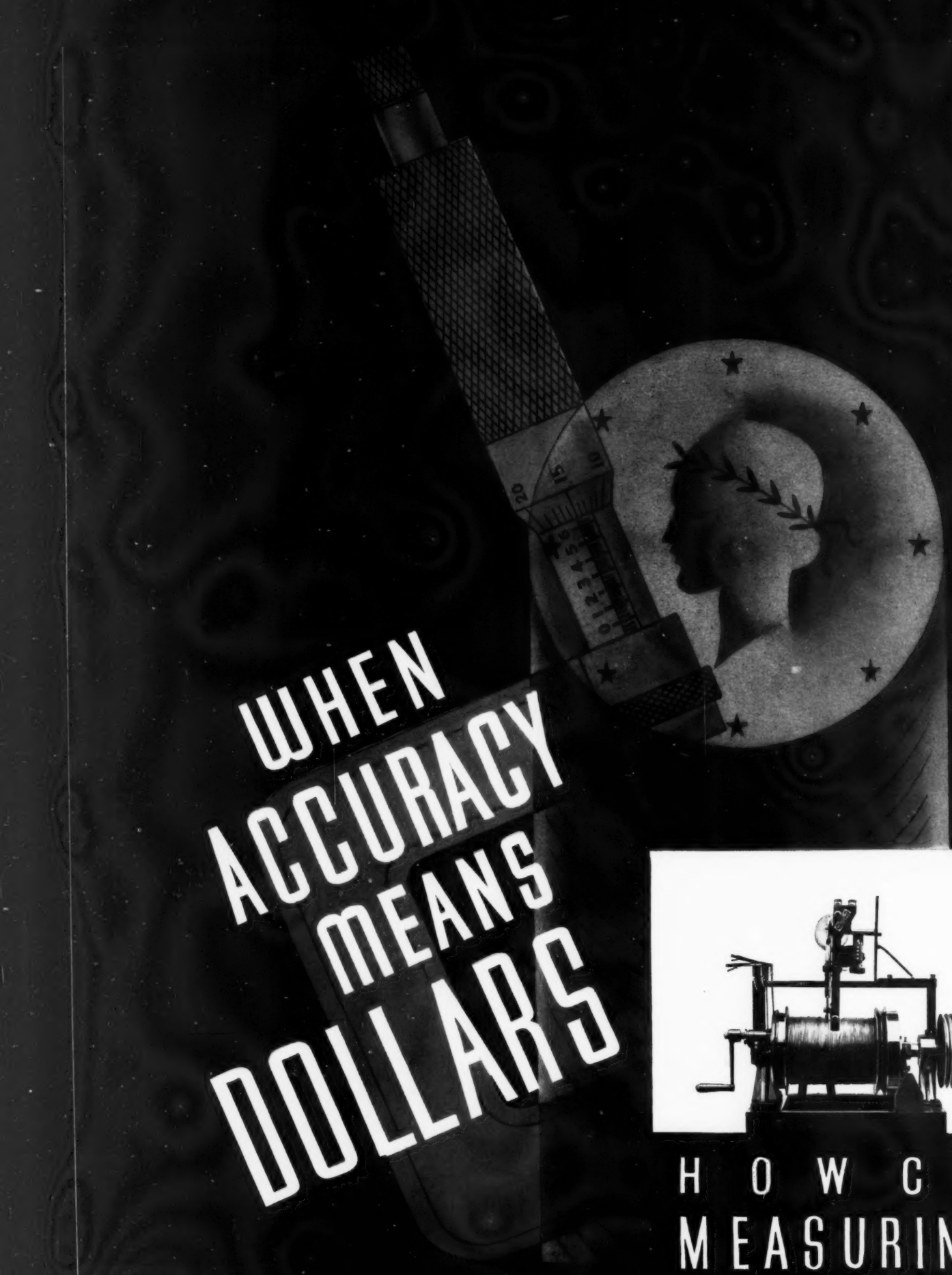

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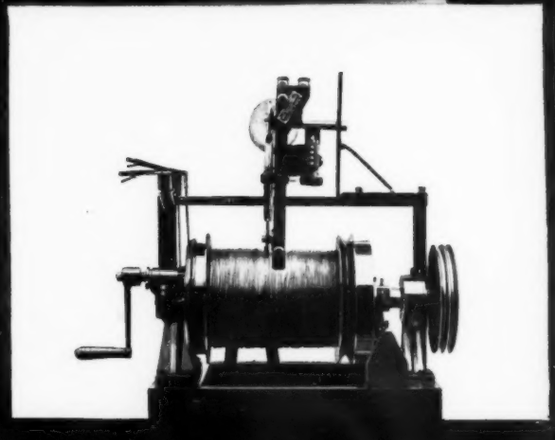

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EDITORIAL

WOULD MAKE OIL A C.I.O. PROVINCE

NOTICE was served long since upon the oil industry that it was to be made a battleground in the struggle directed by John L. Lewis to make himself supreme dictator of all American industry. The date for commencement of an intensified attack upon petroleum is brought measurably near by announcement of the early opening of headquarters for the movement in the heart of the oil country.

Emerging from the settlement of the General Motors strike with a dubious claim to victory, but with at least a foothold in the affairs of the company, Lewis and his cohorts are preparing now for their widely advertised assault upon other industries and are setting up preliminary plans for an aggressive movement against oil.

It is high time, therefore, for workingmen in the oil fields and refineries, for business men whose stake in oil is large or small, and particularly for state and local officials whose duty is the enforcement of law and order in the oil country, to consider exactly what this threatened invasion portends.

They have before them a vivid illustration of its meaning in the record of what has taken place in Michigan and neighboring states in recent weeks. The so-called sit-down strikes in the motor manufacturing and related fields bore no resemblance in methods or purposes to previous labor struggles in the United States. They gave expression to no sentiment arising from within the ranks of the industries concerned but represented the attempt of an outside group to impose its authority upon employee and employer alike. They sought to accomplish this end by stirring up the fratricidal passions of class hatred, borrowing from European communists the weapons that have been used with destructive effect in class struggles there.

Labor in America has attained a position far superior to that which it occupies anywhere else in the world. It has reached this enviable state largely by individual ability but partly by collective effort. Its right to be consulted in the conduct of industrial affairs is recognized universally. Its right to quit work as a means of enforcing its demands upon employers is unquestioned.

All this has been brushed aside by John L. Lewis and his Committee on Industrial Organization. At their orders the property of employing firms has been seized and occupied and they have defied the orders of the courts to eject the invaders. Picketing is conducted, not by workers from the plants affected but by the imported Janissaries of the Lewis organization. The right of laborers to bargain through representatives of their own choosing has been replaced by Lewis with the demand that he and his group, though comprising a mere handful of the actual working force, shall have the sole right to bargain.

The issue is not one of unionism. It is a question whether a bold and unscrupulous dictator who claims to have purchased political immunity can impose his will upon workers and employers alike.

We do not believe that John L. Lewis will succeed in making the oil industry his vassal. Its members, whatever their position or pay, are too independent to submit to this kind of alien control. State and county officials in the oil country are not disposed to take orders from carpetbaggers. But he undoubtedly will make the effort and will not abandon it until a maximum of disorder and financial loss has been inflicted upon the oil industry.

It is significant of the character of this agitation that its effect has been in direct ratio to the supineness and acquiescence displayed by state and local officials. Where fear of the asserted but nonexistent power of the agitators, or an essentially corrupt agreement with them, has stayed the hands of governors and sheriffs, where court orders have been ignored and state troops employed to aid in accomplishing the purposes of the agitators the disturbance and interference with the orderly conduct of business has been protracted. Where fearless men, determined to uphold their oaths of office, are in authority, the attempt to establish a dictatorship over labor has made no headway. State governors of both political parties in a number of states have served notice that they will tolerate no seizures of property, no defiance of courts and no intimidation of workers. In these states the typical Lewis tactics have not been attempted or, if strikes have been called, they have been of brief duration.

MOTORISTS SUPPORT ARMY OF TAX EATERS

IN ANCIENT Burma the men who held the right to exploit the oil wells existing there for centuries past were called "well eaters", the Burmese word meaning to eat being the same as that applied to doing business. Today in the United States one of the greatest problems of the petroleum industry has come to be that of supporting, not well eaters but a growing horde of tax eaters. The situation is not one that affects the handlers and users of petroleum products alone. It confronts every worker and every form of business activity. But it happens that oil has proved to be a ready and prolific source of revenue and its consumers have shown themselves an easy going lot who have offered little protest and no real resistance to the increasing demands of the tax eaters.

In the eighteen years since the first state laid the first tax on gasoline for the support of a program of highway construction the amount raised by such imposts has risen to $880,000,000 annually while the whole amount derived from motor and petroleum taxes has reached $1,523,000,000 or 14 percent of the entire tax bill of the country. So long as the amounts collected in this way were devoted to road building and maintenance there was little objection from those who paid the bill because they felt that they were benefiting by the expenditure. In the past few years, however, more and more of these funds have been bestowed upon public enterprises which bear no relation whatever to the original purposes for which the tax was levied.

In a number of states, when the depression was at its worst, revenues from gasoline taxes were employed in emergency relief. Now that the emergency has passed the habit of dipping into these funds for all sorts of purposes, from educational support to studies in the propagation of oysters, still persists. In some states, as in New York, it actually is proposed to increase the gasoline tax in order to carry out programs of social legislation.

Prevention of such diversion of funds, provided primarily for road construction and maintenance, even to the neglect of the roads themselves, are difficult to prevent. State legislators with pet schemes to promote find it easy to draw the necessary appropriation from this convenient source. If the funds available are insufficient to meet all demands it is simple to raise more millions by putting another cent a gallon on the gas tax.

Hope of placing some curb upon this abuse now appears in the position taken by Congressional leaders against the extension of federal aid in road construction to states which do not employ their own receipts from gasoline taxation to this purpose. As Representative Cartwright, chairman of the Roads Committee of the House of Representatives, points out on another page, states which display no interest in exerting efforts of their own to improve their highways clearly are not entitled to federal assistance in accomplishing that task. If this policy of withholding federal support where states divert their gas tax funds to extraneous objectives is adhered to consistently it undoubtedly will have an appreciable effect in lessening the tendency to such diversion.

This of course is only one angle, although an important one, of the general problem presented by the mounting taxation of motors and motor fuel. Because gasoline taxes are collected in small amounts their full incidence is not appreciated by the average motorist. An illustration of their actual volume has been provided by one garage proprietor in one of the suburbs of New York who kept a record of the amounts paid in taxes by his patrons during the past year. This record included of course only the fuel supplies purchased directly from him. It showed, however, that individual motor car operators paid in state, federal and city taxes on their fuel purchases sums ranging to $100 and upward, representing some 25 percent of their total expenditure for fuel. There are other states in which the gasoline tax is higher than in New York and in which the amount paid annually by consumers would be correspondingly greater.

The tax on gasoline and oil is a sales tax. General sales taxes are seldom more than one or two percent. When they rise to 20 and 30 percent they clearly are exorbitant and represent a ruthless class discrimination, but until the great body of motorists register their disapproval in strong and definite terms their burden is not likely to be lightened. If they could visualize in passing procession the army of half a million tax eaters supported by them their protest might become more vocal.

MEXICAN MONOPOLY

MEXICO'S policy over a series of years may be fairly appraised as designed through successive steps to establish a petroleum monopoly without undergoing the necessity of compensating companies already in the field for loss of their business. A further stage in this program was reached March 1 with the dissolution of Petromex and the establishment of the Administracion General del Petroleo Nacional (AGPN). The new organization will operate in all branches of the petroleum industry in Mexico in competition with the privately owned companies whose capital discovered and developed the Mexican oil industry. Being a government agency it presumably will be free from the labor troubles that have proved so harassing to its competitors. By exemption from taxes, expropriation of doubtful claims and advance title to all recognized leases as they expire it should have no difficulty in gradually absorbing the business of its competitors and leaving them no alternative except to withdraw from the country. Any compensation that they could ask for then would be much below the present value of their properties.

Whatever advantages a monopoly offers to the politicians it affords none to the public, judging from the experience of countries in which it has been tried. Under the monopoly in Spain, for example, motorists complained that they obtained the lowest grade, highest priced and worst serviced gasolines in Europe. But in matters of this sort no government seems willing to learn from the experience of another.

TAX DIVERSION

May be Curbed by Federal Legislation. Code Approval May Depend on Outcome of Madison Indictments

WASHINGTON—MARCH 5TH

As MARCH opened a development of great interest to petroleum was in the making on Capitol Hill: a movement to prevent Federal-aid highway fund grants to States that permit diversion of gasoline taxes to other than road-building purposes.

This movement was being advocated by Representative Wilbur Cartwright of Oklahoma, Chairman of The House Roads Committee, who contends that diversion practically nullifies U. S. road aid. He continues:

"Congress can not be expected to continue indefinitely attempts to help complete the highway systems of those states which pursue the indefensible practice of misappropriating their own gasoline and other motorists' special taxes to purposes not related to highways."

While Cartwright himself as yet has submitted no definite proposal for settling the problem, it appeared a certainty that one would be put forward in the near future. The situation has been receiving extensive consideration in the meetings of the committee recently.

When a way to halt or curb diversion is presented, whether it can obtain Congressional approval probably will rest on whether motorists are sufficiently aroused to complain long and loudly and insist on its passage, and whether the petroleum trade associations lead the foray.

Diversion of taxes, originally devised for construction, improvement and maintenance of highways, has long been a growing source of irritation to motorists. They feel that they are being discriminated against when such revenues are used for other purposes, no matter how worthy these purposes may be.

Not for more than 12 years have all such revenues been used strictly for highway purposes. During this period highway tax diversion has reached the staggering total of more than $750,000,000.

The practice of diversion is definitely on the increase despite the fact that figures, brought out at a Congressional hearing, showed that only 373,000 of America's more than 3,000,000 miles of roads are improved with any type of surface. Less than half this improved mileage, or about 160,000 miles, is paved mileage.

Like the weather, much has been said and little done about it. But now the matter appears to be coming to a head. Some hope for the motorist lies in the fact that the situation has attracted the attention of Congress which, having already formally denounced highway tax diversion as "unfair and unjust," now threatens to clamp down on those states. The most likely form would be restriction of federal highway aid.

This well defined sentiment in Congress has crystallized mainly because at the present time the federal government is pouring into state coffers something like $244,000,000 annually, to be used for highway purposes. And for the first time in history, Congress has made provision for helping states improve their secondary and "feeder" roads by appropriating for this purpose $25,000,000 for each of the years 1938 and 1939. At the same time, diversion of state highway funds for non-highway purposes has been estimated at around $200,000,000 for 1936.

Representative Cartwright pointed out that only four states—Maine, Missouri, Minnesota and Colorado—have taken legal action to protect their road funds, and called attention to the fact that in 1935 "borrowing" and diversion of motor vehicle taxes were practiced in 36 states.

Total motor vehicle revenues for that year amounted to about $942,000,000 of which $142,000,000 or approximately 15.5 percent was used for purposes not related to highways. New York was the worst offender, using 58.6 percent for non-highway purposes. South Dakota and Massachusetts ranked second and third with diversion of 41.4 and 40.2 percent, respectively.

At present the only weapon available for Congressional reprisal is exercise of a clause in the Hayden-Cartwright Act which permits restriction of the normal prorated allotments by one-third. So far, this clause has been inoperative and it is generally conceded to be more or less ineffective and hard to invoke in view of the fact that such state allotments are generally regarded as choice morsels of federal "pork."

However, Rep. Cartwright says, Congress can provide an effective method of reprisal through enactment of an amendment to the act of 1934 which would specifically prohibit allotment of federal highway aid, under the act, to any state guilty of diverting its own road funds.

A myriad of events of prime import to oil, nationally and internationally, moved toward conclusions in March as February closed on a busy capital city, activity rampant on administrative as well as legislative fronts.

Representative Wilbur Cartwright proposes withdrawal of federal highway aid to states who divert revenues derived from gasoline taxation to purposes other than highway construction.

The month drew to an end with the opening of hearings on whether the petroleum trade will have a voluntary code to replace the almost-forgotten NRA code, before the Federal Trade Commission.

Earlier, the Congress had taken up through the Senate Finance Committee the question of whether to make the Connally hot oil act, which prohibits interstate shipment of excess oil, permanent or let it expire June 16.

Among these two major developments, stood others of lesser moment but equal importance:

1. A movement to submit a stiff bill for regulating the natural gas industry, containing some of the provisions of the Connally Act, some of the O'Mahoney licensing act, and a few of its own. This will come from Chairman Clarence Lea of the House Interstate Commerce Committee.

2. A report from the Natural Resources Committee to the President, which will, in effect, propose that the States and the Federal Government use their taxing power to compel unit operation of public land oil development. A strong report, severely criticizing the interstate compact as merely a blind, was drafted once by the Committee, of which Harold L. Ickes is Chairman, but the draft was not acceptable to the superiors and was sent back for softening.

3. A new Patman bill, to divorce wholesaling and retailing from manufacturing,

where integrated operations act to the distinct detriment of competitors.

4. Extension of the reciprocal trade treaty powers of the President and Secretary Hull for another three years.

5. The perennial question of taxes, including all the domestic nuisance taxes, which expire with June 30, and some new ones, including the veteran move to increase the excise taxes on oil imports by doubling them, and another to levy a cent a gallon domestic tax on fuel oil.

6. Packing of the Supreme Court by the addition of six Roosevelt justices.

The last one is important to all business as well as oil—and probably will be accomplished as the best odds here indicate that the President has a rating of about 60 to 40 in his favor.

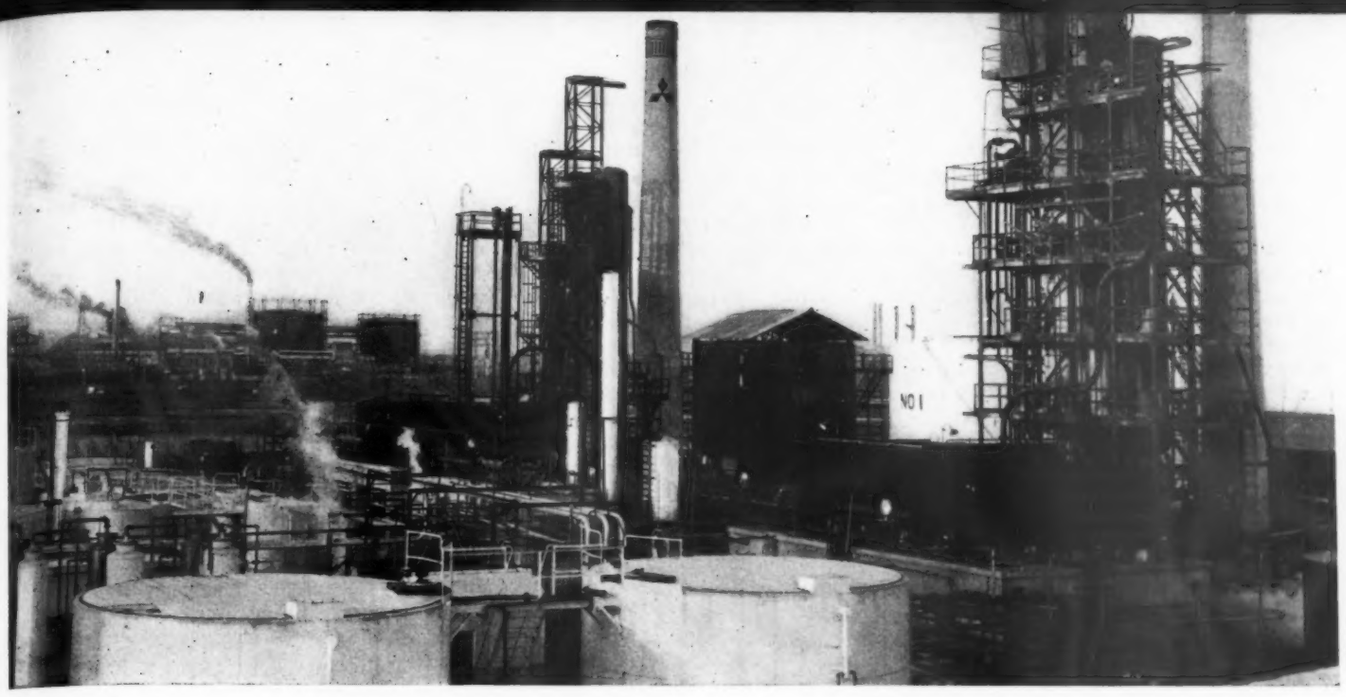
Hearings on the API-et al code, proposed originally within a month after the NRA was killed by the Supreme Court, opened February 24 before The Federal Trade Commission, in formal procedure. The first question to be disposed of was that of cancelling the old 1931 code. This had not been done as this was written, but it was agreed that it would be done. Intermingled was a report that it would not only be cancelled but the new code not approved until after the outcome of the Madison indictments.

The new code's hearing on the opening was marked by three conspicuous absences: Charles E. Arnott, who fathered it for the American Petroleum Institute; Wilmer Schuh, who urged it for The National Association of Petroleum Retailers, and Paul Hadlick, secretary of The National Oil Marketers Association. These three, with B. L. Mahewski of Deep Rock Oil Corp., Chicago, advocated the code through the land for months, but none was present when it came up except Mahewski.

Conally's hot oil extension act was due for passage in the form in which it was proposed. By general agreement, extraneous amendments, such as labor sections and prohibitions against refiners engaging in jobbing or integrated companies being both wholesalers and retailers, were prohibited. Efforts to introduce them came to naught. Except for weak opposition from several jobbing elements, led by Hadlick and aided by Clarence Schock of Mount Joy, Pa., the extension act was given a royal sendoff by committee witnesses, including the Texas State contingent and Interior Secretary Harold L. Ickes.

Roosevelt's judiciary reorganization proposals virtually halted any other important Congressional action on other subjects in February and left a terrific hangover for attention in March. It was about all that members of Congress could talk about—and about all that constituents would talk about in letters and telegrams.

Production activity in a famous California field; Signal Hill. Photograph, courtesy Orville Logan Snyder.



A recently constructed cracking plant of the Mitsubishi Oil Co., Ltd., in Japan, where high yields of petroleum products are becoming more and more important.

OIL IN THE FAR EAST

While Commercial Needs and the Ambitions of International Companies Stimulate the Search for Petroleum, Diplomats and Strategists are Formulating Plans Based on Possible Discoveries

IN THE WORLD wide search for oil attention is being directed to areas which heretofore have been neglected or passed over because of their inaccessibility or because of the heavy cost of exploration and development. Today the urgent need of the world for more and more petroleum products is causing the search to be extended to every corner of the globe which offers the slightest hope of yielding the black gold of commerce which is at the same time a fundamental necessity for national defence.

Within the past few years every part of the Near East has been brought under concessions for exploration and at least one field of major importance has been developed there. Even Afghanistan is being subjected to a thorough survey. Activity in South America is being pushed to further areas. In what was once described as darkest Africa drilling is going on and even in frozen Kamchatka geologists are endeavoring to determine whether prospects justify the test of the drill.

This unappeased oil hunger has caused attention to swing back to the Far East and to be focussed on unexplored portions of the vast island areas lying between the southeastern tip of the Asian continent and the open spaces of the Pacific eastward of the 180th meridian. Within this region lies New Guinea, comparing in extent with that part of the United States lying east of the Mississippi and north of the Potomac and little better known than it was three centuries ago. It includes Sumatra, with an area four times that of Pennsylvania; Borneo, which is larger than Texas, and numberless other islands, large and small.

For many years the East Indies have been an important factor in the international oil situation. Certain of the islands forming part of the colonial empire of the Netherlands have been producing petroleum for over forty years. Java was the cradle of the great Royal Dutch organization which since has spread its activities to every part of the world. For a quarter of a century Sarawak and, more recently Brunei, extending along the northwest coast of Borneo, have been tributaries to the great river of oil which flows ceaselessly from distant parts of the world to those countries where industrial development is most advanced and consumption consequently heavy. Production in the entire area has grown steadily but not rapidly for many years and now stands at about 50,000,000 bbl. annually. This is something less than three percent of the world's output but it is an important quantity considered by itself and it comes from a relatively small proportion of the potentially productive area.

By reason of its long continued operations the Royal Dutch group is the chief factor in petroleum activities in the East Indies. N.V. de Bataafsche Petroleum Maatschappij, the principal operating company of the Royal Dutch in this part of the world, with producing and refining facilities in Sumatra, Borneo and Java, handles more than half the output of this entire region. In addition to its own properties and those of directly owned subsidiaries it works a number of concessions held by other groups, operating these on a royalty basis.

Deposits being worked by the Royal Dutch interests are located in central Java, in the southeastern part of Sumatra, on the island of Ceram, on the eastern coast of Dutch Borneo and in Sarawak, Brunei and British North Borneo on the northwestern side of that island. Refineries are located

at Tjepoe, Java, at Pladjoe, Sumatra, at Pangkalan Brandan in northwestern Sumatra and at Balik Papan in eastern Borneo, with a combined capacity of about 75,000 bbl. daily. Products of these refineries supply the local markets in Netherland India and are exported to other marketing areas of the company in the Far East.

Standard Oil Company (New Jersey) for many years owned through subsidiaries producing wells in southeastern Sumatra and in Java with refineries at Palembang, Sumatra and Rembang, Java. When the Standard-Vacuum Oil Co. was organized in 1933 under the joint ownership of Standard of New Jersey and Socony-Vacuum the properties in Netherland India passed to Standard-Vacuum which since has enlarged the Palembang refinery to make it the largest and most modern in the Far East.

Until a year or two ago the important operations of the petroleum industry in the East Indies were in the hands of the Royal Dutch and Standard-Vacuum groups, production was confined to well developed fields that had been in operation for several years and exploration was of limited scope. Since 1935, however, there has been a great increase in activity, particularly in exploration, for which several factors are responsible.

First of these, of course, is the increasing pressure to locate new reserves of oil for which the world is crying impatiently. Supporting this is the advance that has taken place in the mechanics of exploration. Improvement in seismographic practice permits a more scientific determination of the probable presence of oil. Aerial surveys enable preliminary studies to be made in areas that have remained impenetrable to land surveying parties. At the present time and for more than a year past such a survey is being made of Dutch New Guinea, covering jungle and mountain territory which has resisted all other means of mastering its secrets.

This survey is being conducted by N.V. Nederlandsche Nieuw-Guinee Petroleum Maatschappij, a company organized in the Netherlands in 1934 with its ownership divided between the Royal Dutch which holds 40 percent, the Standard-Vacuum holding 40 percent and the Standard Oil Company of California owning 20 percent. The operating partner is Bataafsche Petroleum of the Royal Dutch group. The company holds a concession extending over 10,000,000 hectares (24,710,000 acres) in Dutch New Guinea. This is to be reduced in the course of ten years to 1,000,000 hectares (2,471,000 acres) as exploration proceeds and the company is able to determine the areas in which it wishes to undertake development. The area to be explored is a fair sized empire, being larger than any state in the American Union and even the part to be held for development is more than half the size of Oklahoma, and therefore capable of producing a large amount of oil if oil actually is found.

In the organization of the Netherlands New Guinea Company, it will be noted, a name appears that has not figured previously among the companies with active interests in this part of the world—that of Standard Oil of California. In the past few years this company has extended its operations far afield from its base on the Pacific Coast of the United States. It has built up a highly important position in the Near East through development of the Bahrein field and its acquisition of concessions in eastern Saudi Arabia. Within the past year it has entered into an alliance with The Texas Corporation by which the two have become joint partners in their operations east of Suez and have organized the Far Eastern Petroleum Company Ltd. to take charge of development and production in that area.

In addition to its interest in New Guinea development Standard of California obtained from the Dutch government a concession in its own right covering 10,000,000 acres in the western portion of Sumatra and organized N.V. Nederlandsche Pacific Petroleum Maatschappij to undertake the exploration and development. Under the terms of its arrangement with The Texas Corporation the latter company acquired a 50 percent interest in California Standard's holdings in both these enterprises so that the California-Texas group becomes a potentially important factor in the further development of the Far East, depending of course upon the extent of the oil deposits which it may discover.

Outside of the Dutch colonial holdings the chief landed proprietor in the area we have been considering is the British Empire. North Borneo is a British possession and Sarawak and Brunei are principalities under British protection. The northeastern portion of New Guinea, or Papua as the English term it, formerly was held by Germany and is now under a mandate of the League of Nations administered by the commonwealth of Australia. The remaining portion of the eastern half of the island is a direct Australian possession.

The Australian government has long been anxious to develop a source of oil supply for the use of its people and from time to time has encouraged geological exploration in various portions of its own continent. During the past year renewed impetus was given to this movement by action of the federal government in establishing a fund of £250,000 to be used in the encouragement of exploration for oil. While results in Australia proper have not been particularly encouraging to date it is felt that greater success may be attained in the Gulf and Delta divisions of Papua and recently several concessions have been granted to explore in that part of the island which is under Australian control. One of these concessions is held by Standard-Vacuum through a subsidiary, the Islands Exploration Company. Others are held by Oil Search Ltd. and Oriomo Oil Ltd., two affiliated Australian companies and Papua Oil Development Company, a Royal Dutch Shell subsidiary. Meanwhile the Australian government is moving toward the development of a shale oil industry at Newnes, in New South Wales, where works for the recovery of oil from shale were erected some years ago. At the same time it is closely studying the possibilities of recovering oil from coal by the process of hydrogenation.

When one turns aside from the great group of islands lying athwart the Equator which has just been considered it is a far jump to any proven oil fields of consequence. To the northwestward and belonging to the Mid-East rather than the Far East lies Burmah, producing something less than 10,000,000 bbl. yearly. All the oil of Burma is less than sufficient to fill the demand of the Indian market. Its efficiently operated, British-owned companies form an important part of the petroleum picture in this part of the world but their products do not enter extensively into international trade.

Along the Malay peninsula and further north, in China, the geologists hold out little hope of the discovery of important oil deposits. Wells were drilled in China three thousand years ago but in modern times the country has been looked upon as offering little promise to the oil prospector.

Directly north of the East Indies are the Philippine Islands, which are still to be comprehensively explored. A few years ago Standard Oil Company of California drilled two dry holes on the island of Luzon and retired from the field as holding little of commercial promise. As a group the islands remain an unknown quantity in the matter of petroleum possibilities.

In any discussion of oil in the Far East, and particularly in a consideration of the political possibilities involved, it is impossible, of course, to overlook Japan. While Japan lies far north of the area that has been discussed its influence, through the mandated islands which it controls, extends down to the Equator, close to the East Indies. Should the Philippine Islands be taken over by Japan or brought within the sphere of Japanese influence, as many observers of Far Eastern affairs consider inevitable, Japan would stand at the very doorway to the rich oil resources of this great group of islands.

Within her own immediate territory Japan, as is well known, holds relatively meagre petroleum supplies. Painstaking exploration of the Empire proper has resulted in the production of about 2,000,000 bbl. yearly, some 20 percent of the country's domestic requirements. From present indications it does not seem likely that this can be greatly increased. There may even be difficulty in maintaining the present output. Extension of Japanese authority over Manchukuo has not resulted in enlarging controlled supplies except for acquisition of the South Manchurian shale deposits which are reported to be used mainly to supply naval and aviation needs. Japan's keen interest in petroleum is demonstrated by the setting up of the Manchukuon oil monopoly and the measures taken to control supplies within the Empire market.

Outside her own borders Japan operates one fairly important field, that of North Sakhalin, which is territorially part of the

OIL MAP of the FAR EAST
Companies, Concessions, fields and Refineries in the Far East in Relation to Consuming Centers and Political Divisions
PRODUCING FIELDS
REFINERIES
OIL SHALE MINES
©WORLD PETROLEUM
SIBERIA
KAMCHATKA
GEOLOGICAL EXPLORATION
SOVIET GOV'T OIL FIELDS
NORTH SAKHALIN OIL CO.
SAKHALIN
MANCHUKUO (MANCHURIA)
REFINERY IN OPERATION
KHABAROVSK
CHINESE GOV'T Test Drilling
MANCHUKUO OIL CO.
CHALOINGER
OIL SHALE MINES
FUSHUN
VLADIVOSTOK
REFINERY UNDER CONSTRUCTION
NIPPON OIL CO.
NIHON SEKIGU KAISHA
JAPAN
YOKOHAMA
to San Francisco - 4,535 Miles
Los Angeles - 4,839 Miles
CHOSEN
CHINA
North Pacific Ocean
TAIWAN MINING CO. Ltd.
TAIWAN (FORMOSA)
BURMAH
YENANGYOUNG
BURMAH OIL CO. Ltd.
BRITISH BURMAH PETROLEUM CO.
SYRIAM
RANGOON
INDO-BURMA PETROLEUM CO.
SIAM
FRENCH INDO-CHINA
LUZON
RICHMOND PETROLEUM COMPANY drilled three dry holes in 1920-24 Bondoc Peninsula, Luzon.
PHILIPPINE ISLANDS
Definite indications of Oil and Seepages have been observed on all the Philippines Islands except Panay
MINDANAO
to Port Moresby - 3,385 Miles
to Berlin Hafen - 2,475 Miles
Calcutta to Berlin Hafen 4,300 Miles
ROYAL DUTCH SHELL GROUP
FEDERATED MALAY STATES
ROYAL DUTCH SHELL Test Wells in 1932
CALIFORNIA STANDARD GROUP
JERSEY STANDARD GROUP
SUMATRA
STANDARD VACUUM OIL CO.
ROYAL DUTCH-SHELL GROUP
ROYAL DUTCH-SHELL GROUP
BRITISH NORTH BORNEO
SERIA
BRUNEI
LUTONG
TARAKAN
ROYAL DUTCH-SHELL GROUP
Joint Drilling by NIPPON OIL CO. and MITSUI CO.
SAKARYTA CONCESSION
MEETE
BORNEO
SEMBOJAN DOLIK POPOH
BORNEO OIL MAATSCHAPPIJ
BARITO CONCESSION
ROYAL DUTCH-SHELL GROUP
N.V. NETHERLANDSCHE NIEUW GUINEA PETROLEUM MAATSCHAPPIJ (Standard-Vacuum, 40%; Royal Dutch-Shell, 40%; S.O.C. of Calif., 20%
MANDATED DEVELOPMENT Test Wells
NETHERLAND NEW GUINEA
ROYAL DUTCH-SHELL GROUP
BERLIN HAFEN
TERRITORY OF NEW GUINEA
MANOPO
PAPUA
PORT MORESBY
ALEGEMEENE PETROLEUM COMPAGNIE
STANDARD-VACUUM OIL CO.
TJEPOE
KARPUEN
REMBANG
SOERABAJA
KEDIRI
MADIOEN
PALEMBANG
JAVA
Indian Ocean
JAVA OIL EXPLORATION CO., Ltd.
INACTIVE
ROYAL DUTCH-SHELL GROUP
Cooperative Exploration of New Guinea by ANGLO-IRANIAN OIL CO. Ltd., OIL SEARCH Ltd. and COMMONWEALTH GOV'T. ROYAL DUTCH SHELL and STANDARD VACUUM GROUPS also active
NEW GUINEA OIL CO's Test Wells at Upoia
TIMOR
TIMOR PETROLEUM CO.

General view of Pamoesian quarters at Tarakan, Borneo, Netherland India.

Soviet Union. Sakhalin island, long and narrow, lies directly north of Hokkaido and the Kurile island. By the treaty of Portsmouth which ended the Russo-Japanese war in 1905 the southern half was ceded to Japan but in this portion very little in the way of petroleum has been discovered. Northern Sakhalin, however, contains a number of fields scattered along the coast. During the world war Japan took possession of this territory and utilized the opportunity to make a careful study of its petroleum possibilities.

In 1925 an agreement was made with the Soviet Union by which a Japanese company —the North Sakhalin Oil Company—acquired the right to operate the proven fields of Sakhalin for forty years, the tracts being divided checkerboard fashion into parcels of 100 acres, each party holding the right to alternate parcels. At the same time the company received the exclusive right to explore for eleven years the unproven area of the island and to select each year not more than 2,600 acres to be similarly divided. The concessionary company pays a royalty of from 5 to 15 percent on flowing wells and from 15 to 45 percent on pumping wells, according to their production. The agreement for exploration expired in 1936 and on account of the somewhat tense relations between the two governments it was only after extended discussion that it was extended for another five year period, to 1941.

Production in Sakhalin has averaged about 3,000,000 bbl. yearly for the past five years. The terms exacted by the Soviet Union would be considered onerous in places where oil is less difficult to find than it appears to be in the North Pacific. Their acceptance by the Japanese company testifies to Japan's anxiety to obtain supplies of crude that would be dependable in the event of war. It is considered probable that in one way or another Japan ultimately will acquire the whole of Sakhalin. In case of hostilities between the two countries the Japanese undoubtedly would move at once to take forcible possession of the oil fields since the oil they yield would be of primary importance to their army and navy.

Since the combined output of Japan proper, Sakhalin and the shale beds of Manchukuo provide far less than half the peace time demands of the country the restless followers of the Rising Sun have been looking eagerly for additional sources of supply that are not too far away. Inevitably their gaze turns southward and they think how agreeable it would be to have the oil of the East Indies at their command. That such thoughts are in their minds is plain enough since the suggestion has been made openly though not officially that if the Netherlands could be induced to turn over to Japan its eastern colonies valuable concessions in the Japanese market would be made to the operating companies now in control of production in that area. Japanese at various times have been aspirants for concessions in the East Indies and at present a Japanese group is drilling in East Borneo without as yet having made any discovery so far as announced. Japan unquestionably would like to acquire production in Borneo or Sumatra or to engage in exploration in any part of the East Indian archipelago. Recently, Hyogoro Sakwai, member of Japan's largest political party, Minseito, proposed in the Japanese House of Representatives that the government approach the Netherlands with a proposal to lease Dutch New Guinea. While the proposal evoked astonishment in the House and denials of territorial ambition from the Foreign Minister it indicates the ever-present anxiety on the part of Japanese legislators to acquire natural resources of the wealthy islands to the south.

Some months ago it was made known that an official accord had been reached between the governments of Japan and Germany. Speculation was rife in diplomatic and commercial circles as to the exact scope of this understanding. So far as the world was informed it provided only for presenting a united front against communism as typified by the Union of Soviet Socialist Republics. Rumors persisted, however, as to secret clauses providing among other things in case of war for a partition among the two governments of islands in the Pacific by which Japan would come into possession of oil producing areas in the East Indies. There is of course no concrete evidence on which to base such a supposition, but rumors no less strange have become realities in the past under pressure of military necessity.

The Soviet Union itself has more than a passive interest in the problem of petroleum supplies for its far eastern territory. Russia has much oil but it is far removed from the Pacific. The Soviet share of Sakhalin oil is of little consequence and there are difficulties in transporting it from the Moskalvo terminal to the refinery at Khabarovsk. As has been pointed out the Russian hold upon Sakhalin oil is precarious and if war should begin supplies from this source, small as they are, would be shut off. As a temporary means of providing against wartime needs of aviation and motor fuel large supplies are believed to be going into storage along the lines of the Trans-Siberian railway. Meanwhile the search for petroleum is being extended further and further eastward into Siberia and the presence of American geologists on the Kamchatka peninsula may be not unrelated to Soviet appreciation of its need for petroleum supplies in that part of its far flung domain.

Students of international affairs agree that the Pacific is to be the scene of most important political and commercial developments in the next twenty-five years. Readjustments in the balance of authority already under way are destined to go much further or to be broken up by the rise of a new national consciousness among peoples that in the past have submitted to outside exploitation. Great changes are inevitable. In these petroleum will play its part, possibly a vital and determining part. Nations which are deficient in supplies of oil will attempt to remedy this deficiency at any cost. Development of the oil resources of the Far East, and of the East Indies, is bound to prove of far-reaching influence on the future course of economic power and political history.

PROBING PIPELINE PILFERAGE

By Elton Sterrett

LAZILY paddling up a moss-veiled bayou, thumbing a ride with some native over a little-travelled by-road, or quartering a patch of timber with a dog, a small-bore shotgun and, at the belt of my hunting jacket, a pair of dangling rabbits—not vacation pictures, but all part of a job which sometimes comes my way under orders from the general superintendent of our Blank Pipeline company, inland transportation subsidiary of one of the larger among the so-called major oil companies.

For the pipeline, though buried from three to as much as ten feet underground, suffers serious loss through pilferage and petty theft of the commodity it transports, even as do other common carriers, the railroad and truck line.

So there are restrictions: the spots covered by the canoeist must center around certain signs posted at the water's edge, reading

PIPELINE CROSSING
DO NOT ANCHOR

which, while serving to caution the honest mariner against dragging up a pipe with his mudhook, also inform the nimble-fingered and even more nimble-witted gentry of the exact location of their potential quarry.

By-roads over which the rides are thumbed must lead toward or cross the pipeline as it heads, with crow-flight directness, from oil field or refinery toward its outlet, possibly hundreds of miles away. And the ride, successfully digited, must afford opportunity for roundabout probing of the native regarding heavy truck operation in his neighborhood, with carefully masked slants directed especially toward the appearance of tank trucks.

As the ride continues, eyes must be alert for the marks of broad treads or dual tires on intersecting trails. These tracks, once spotted, must later be followed to their end while rambling over the countryside in the guise of a hunter—the dangling rabbits, the darting hound and the (light weight) gun all being "props" rented to bolster the part and render appropriate background.

As with the railroads, most of whose losses occur when car seals are knocked off and from a few cases to a carload of freight stolen, so with the pipelines the great majority of line losses involve some individual who has drilled, sawed, punched or otherwise perforated the line, drawn off what he wanted, and gone his way; making little or no attempt to cover his tracks—or even to restore the line to its previous pressure-carrying tightness.

In East Texas, shortly after a natural gasoline plant had begun producing and pumping its product through a five-mile line to a loading rack on the nearest railroad, both a drop in the initial or pumping pressure as recorded at the plant and a frantic telephone call from the loading rack man indicated something had gone wrong with the line. Even before the pump could be shut down and a crew dispatched to walk the line and locate the leak, there thundered a sudden explosion, followed by a towering blaze visible alike from loading rack and gasoline plant.

Checking into the origin of the blast after the victims had been rushed to morgue or hospital—the explosion having been set off when wind-borne gas reached the smouldering embers of a campfire, there to flatten and set ablaze two crowded tents and fire the underbrush for a quarter of a mile—a square perforation was found through the top of the pipe, evidently made by sledging a railroad spike into the line, such a spike exactly fitting the gap being located in the ashes near the hole.

Dual truck tires wound their trail from the spot up a draw to a neighboring wood-road, then disappeared on the main highway. The gasoline thief had not even troubled to drive the spike back into the line after filling his tank, and the highly inflammable liquid had continued to pour through the gap he left until its spreading pall of vapors reached the nearest fire.

The majority of loss cases resolved themselves into tracing similar crude pipe-tappings, many being discovered by the line walker or patrolman in the course of his routine line inspections—or intentionally passed by him, for me to locate readily, if the inspector chanced to be in cahoots with the pilferer.

I MAKE A HOLE-IN-ONE

One of the most ingenious cases which showed the mentality being warped to oil-theft came my way early in the life of the great East Texas field. At irregular intervals the nightly run from a certain section of the field would show almost exactly 400 bbl. short. This, at a dollar a barrel, meant $400.00 gone.

When both line-walker's and a pipeline gang check-up reported everything apparently in order, there came the main office memo wishing the job on me.

Nothing amiss developed after a canvass afoot of the territory involved. The gathering main under suspicion carried the daily runs from eight of our own producing leases, as well as odd lots from a dozen other producers who occasionally sold or traded us crude.

Undisturbed ground covering the line checked the evidence of office records and both were corroborated by reports filed in the Railroad Commission offices—no new lines within the year came close enough to tap our field main. With this item to go on, the theft must be, could be, taking place only through some line and connections already in place.

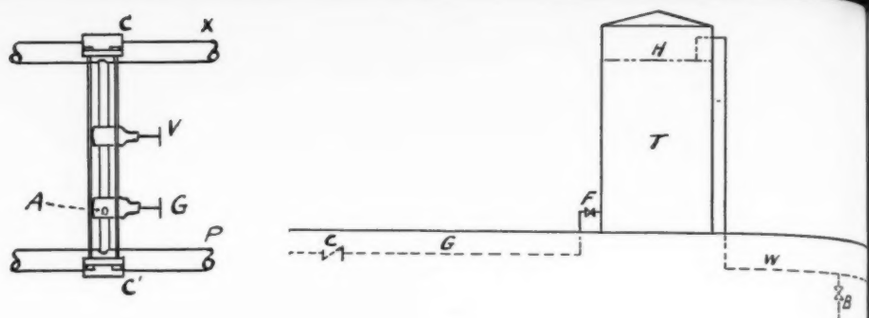
Comparison of run tickets showed that the loss had been borne on different occasions when each of the outside producers had been delivering oil to us—this same tying in of outside pump stations effectively killing any hope of locating the time and probable location of the loss through a study of controlled line pressures.

Early in the work, the amount of each loss impressed me. Four hundred barrels did not match the capacity of the usual oil field lease tank battery, but did represent almost to the barrel the combined cubic contents of two modern railroad tank cars. Acting on this hint, I donned a pair of overalls and braced the local railroad officials for a brakeman's job. As expected, I was turned down, but by hanging around as the night switching crews were made up, I soon got to know the men who handled the tank cars in and out of the section in which our loss was occurring.

With an accumulation of car records at hand, I checked daily loadings of the various independent producers against our own shortage column. Head and shoulders above the mass of data stood one item: every time we checked short the X.P.D. company loaded out two more cars of crude than on a corresponding night of the week when we suffered no loss.

I was convinced the leak was located, but could not go to the superintendent with an unsupported belief. So a squatter, in no way distinguishable from hundreds of his kind distributed over the vast East Texas oil terrain, set up his sheet iron and canvas hovel in a grove not fifty feet from where the X.P.D. line was tied in with ours.

A long week of mosquito-harassed vigils followed, at the end of which I was willing to take oath no one save the slowly plodding line walkers had come within a hundred yards of the pipeline junction—yet on two of the seven nights while I kept watch the



Left; tie in of our line with X.P.D. line. X—their line, P—our line, V—their gate valve, G—our gate valve (drilled by X.P.D.), A—position of croquet ball closing off leak. Right, Zarepta lease hook-up; W—flow line from well via separator, F—gate on tank, G—gravity outflow line, C—check valve nullified by switcher's magnet, B—by-pass to hot oil refinery.

runs had checked short by the usual two tank cars.

The X.P.D. company's line crossed a good three feet above ours: laid early in the field development, the tie-in between the two four-inch mains being a short riser of two-inch pipe, welded into the top of our line and into the bottom of the other, with two gate valves in the short span, each fitted with ears and padlocked in the closed position. The lower gate was ours, and released presumably only by our keys, the upper equally as effective a stop unless released by the X.P.D. key. To insure against the padlocks being moved without my knowledge, I had forced a bit of paraffin into the apertures of each upon beginning my vigil, and found the plugs still exactly as I had placed them when I finally went in to admit my inability to trace the thief.

On the way to the office, pondering over the hook-up, I wondered at the tying together of the two lines with saddles and long bolts, and was told that the reinforcement was added by the X.P.D. folks after the weld had sprung a leak where the two-inch main joined their four-inch main.

Somehow, that strengthening seemed phony, superfluous, and I went back to examine it more closely, enlarging the pit which gave access to the two padlocked gate valves until the saddle around our line was exposed. The bolts had been pulled piano-string tight and then the nuts had been electrically welded to the projecting threads. To remove the saddles would necessitate cutting the supporting bolts—and that our superintendent refused to sanction.

Still convinced that in some way the missing oil must escape through the two locked gates, I sought to find if either had been tampered with, but learned—as was usual practice—that the locking device encircled the body of each valve so that it was impossible to remove the stem with the lock in place.

As I scowled at the innocent appearing pipe an idea, a possible method of stealing the oil, occurred to me. At the best speed my old wreck would do I detoured via Longview and the nearest of the five-and-ten-cent stores, there to invest in a child's croquet set; then sped to the office to pick up my boss, winding up at the field pump heading the far end of the line sustaining the losses.

With no pressure on the line, I opened the discharge from the pump and inserted one of the croquet balls into the four-inch pipe. Then, delaying the start an hour beyond the usual time, we began pumping, eyeing the pressure gauge carefully for any sudden rise.

The night's run went off uneventfully for us in the little pumping shack, but the morning check of receipts at our pipeline tank showed the loss had dropped from 400 barrels to a scant 50.

The croquet ball, floating and rolling with the stream of oil in the pipe, had travelled past all openings into our line through which oil was coming to join that being forwarded by the pump my boss and I were watching, to rise with the diverted flow into the guilty line. There I figured the ball, 1¾ inches in diameter, would hang up if our gate valve had been tampered with.

A month later the pipeline gang checked my hypothesis. The X.P.D. outfit had drilled the top of their line and down through the axis of the two-inch connection—after having removed the gate portion from within the body of their valve—and had drilled a 1¼" hole through the center of our gate valve. The hole atop their line had been closed by welding in a plug, and the bolted saddles added to mask the tell-tale weld. The ball which I had started through more than four miles of pipe was found, still firmly seated against the lower edge of and completely sealing the opening drilled through our gate. Truly I had made a hole-in-one.

THE SCIENTIFIC TRUCK-DRIVER

When the company built its first plant in the East Texas field for the extraction of natural gasoline from the gas which flowed the crude petroleum, the block of leases acquired favored the location of the processing equipment a good six miles from the nearest rail connection, necessitating a four-inch welded line to carry the finished product to the loading rack, where the gasoline was piped into waiting tank cars.

Midway of this distance the line traversed a small settlement of roughnecks, switchers and other oil field workers, and one break followed another as the pipe was tapped to provide free fuel for some broken down flivver—or add its mite to some one's illegal income.

After each break our claims department was hounded by a truck-driver from this community, Howell by name, who claimed—with numerous bottles of gasoline-tainted water to prove it—that leakage from the break had seeped underground to his water well, there to mingle with and ruin his supply.

After cleaning his well and paying out a tidy sum on each of three occasions to compensate the man for his trouble, it was decided to lower the line through his settlement to put temptation farther out of reach. At the same time, because this lowered ditch would be nearer Howell's water level, his well was to be driven another forty feet to the next known water-bearing sand.

To make a good job better, the completed well was lined from ground level to water sand with a curbing of 15" tile, grouted into place and with a Tee section and single horizontal tile set just above standing water level to accommodate a small electric pumping unit. These details are given because, unrelated as they seemed at the time, they had a bearing on what initially seemed a most puzzling transformation of high test natural gasoline into salt water.

After being lowered the line carried on a good three months without a single case of tapping being reported, and our deliveries to tank cars checked closely with plant output, less the usual—and predictable—loss by evaporation when handling such a highly volatile liquid.

Then we began to get complaints from the refinery to which our natural gasoline was being shipped. Occasionally a tank car of otherwise specification stuff would contain from three to five hundred gallons of salt water.

Refinery laboratory tests demonstrated that this salt water carried the identical percentages of the same impurities as that produced with the crude oil in wells bordering the western edge of the field. But the gasoline plant superintendent and our engineering department were one in declaring that it was impossible for this water to come from wells with gas and travel through the entire processing plant to emerge as salt water in shipment after the gasoline had stood in the plant stock tanks.

Careful thieving of these same stock tanks, run by me as check after being put on the job of tracing down the salt water, failed to find more than a trace of water—and this fresh—in any of the tanks. When I suggested that the salt water was being run into the line to replace gasoline being stolen, all the help I got was unlimited leave of absence from my desk and a curt "Prove it!" from my boss.

There was absolutely nothing to start from. Careful pumping records had been kept, but none of the recorder charts showed the characteristic pressure dip and recovery usually indicating molestation of the line. Double sealing of the tank cars as they were filled proved that the substitution was not being made between the time of leaving our loading rack and arrival at the refinery.

The line walker was positive there had been no change in the ground overlying our line since the lowering job through the settlement—and the salt water had not made its appearance until months after that work was completed.

As a roughneck seeking work, I drifted into the little community, and found lodging with a driller who managed to get me an occasional day's work on his rig when one of the regular drilling crew felt disposed to rest. Other than that, all my daylight time and uncounted hours of the night went to checking and rechecking the line and watching for the slightest hint which could direct my efforts.

In common with the other families, our household used shallow well water for all but culinary needs, buying this last from the Howell's deep well. His water supply was so much superior to that generally found in sub-surface or shallow wells in that part of the field that Howell had built up a profitable business hauling water in an old tank truck and selling it in bulk to a company blending and bottling soft drinks.

Other than his truck, no conveyance came near our line which was capable of carrying away the gasoline which, I felt sure, was somehow being replaced by salt water. And Howell's truck was not fitted with pump for effecting the transfer. More, I had surreptitiously tested the flow from each of the four faucets ranged at the rear of the truck, and always drew only pure well water at each. To accuse Howell on mere suspicion was preposterous, out of the question.

With a flow of nearly 100,000 bbl.—over 4,000,000 gal.—of salt water from the field every twenty-four hours, checking the source of the few gallons appearing in our gasoline line seemed to put the proverbial "needle-in-the-haystack" hunter in the piker class, but no other approach to my problem offered.

Because I was in the North end of the vast field, I began checking the wells nearest at hand, and was fortunate enough on my ninth day out to chance across a tank truck being filled from one of the settling ponds used to separate the last bit of entrained oil from the saffron-hued salt water. My casually expressed wonder at the action brought the response that the water was being used as binder on lateral roads thereabouts.

Taking the truck's licence number followed, and there coursed an anticipatory tingle along my spine when the name Lombard tied in as the patronym of the family into which Howell had married. It was not particularly difficult to discover that Howell frequently ran his truck into the garage which housed his father-in-law's three vehicles, but the place was as bare of cover as a bald head to a dandruff germ, and there seemed no way to prove what must be the second link in my chain—transfer of salt water from a Lombard truck to the Howell unit.

Open during the day, with old man Lombard puttering around any trucks in need of tinkering, at night the steel doors were padlocked, and heavy wooden shutters swung across the gable end windows. An enclosed passageway connected house and garage. Two big German police dogs roamed the yard at night to make the neighborhood unhealthy for prowlers.

Twice, as line walker returning from his round, I had thumbed a ride on the Lombard truck from the salt water pool to the garage driveway, and each time the lurching roll of the vehicle had betrayed a part loading of liquid.

The problem was to get into the garage and find cover. When an awaited foggy night came, I crouched in the shrubbery beyond the driveway, armed with a boy's slingshot. When the big bulb over the double doorway blazed to facilitate truck entry, I watched until the old man tipped his chair against the sheet iron wall, to fill his pipe and sit drowzily puffing.

Shooting from my covert, I flipped one pebble after another at the light bulb. A resounding tang-g! announced a hit on the reflector and the old man got up, peered curiously into the fog, then eased himself again to his seat. My next try was a bull's-eye. In the sudden darkness only a winking rectangle of light warned that Lombard had entered the house.

Into the grey blankness of the garage I slipped, hiding temporarily in the cab of the truck nearest the wall. As the old man returned with ladder and lantern I noted that the next truck had the hood raised, the running boards piled with cylinder head, air cleaner, pistons and other parts.

While Lombard climbed the ladder and wrestled with the shattered stub in the light socket I slid from the cab, ducked around the tank, and squeezed into the space between engine block and radiator, easing the hood down to lock myself into a virtual straitjacket with what seemed like hundreds of protruding bolts, knobs and wires to add to my misery.

Cramped, every breath a torture as the hood hinge pressed into my back, I heard the roar of heavy motors. Bright headlights stabbed through the louvres as though to single me out. Right at my ears sounded a gruff growl. The big dogs, unleashed, and bounding out to greet the drivers, had picked up my trail.

Breathless I huddled, taking hope as the younger Lombard merely growled a curse at the dogs. Perhaps five minutes the two drivers puttered around. Then I heard the whirring start of the air compressor, a final shout at the dogs, and the slam of the big doors. As the men's footsteps sounded in the covered passageway the lights went out.

For what seemed endless hours the compressor chugged, then the lights blazed again. The newcomer was Howell, and the dogs were not with him. Eye pressed close to louvre, I could not see the man as he moved about, but the motor stopped, there was the sound as of a tank top dropping, and then, a moment later, a truck starter whined. With the third impatient blast of the horn old man Lombard came to unbar the doors, let the truck drive away, and then make all fast again.

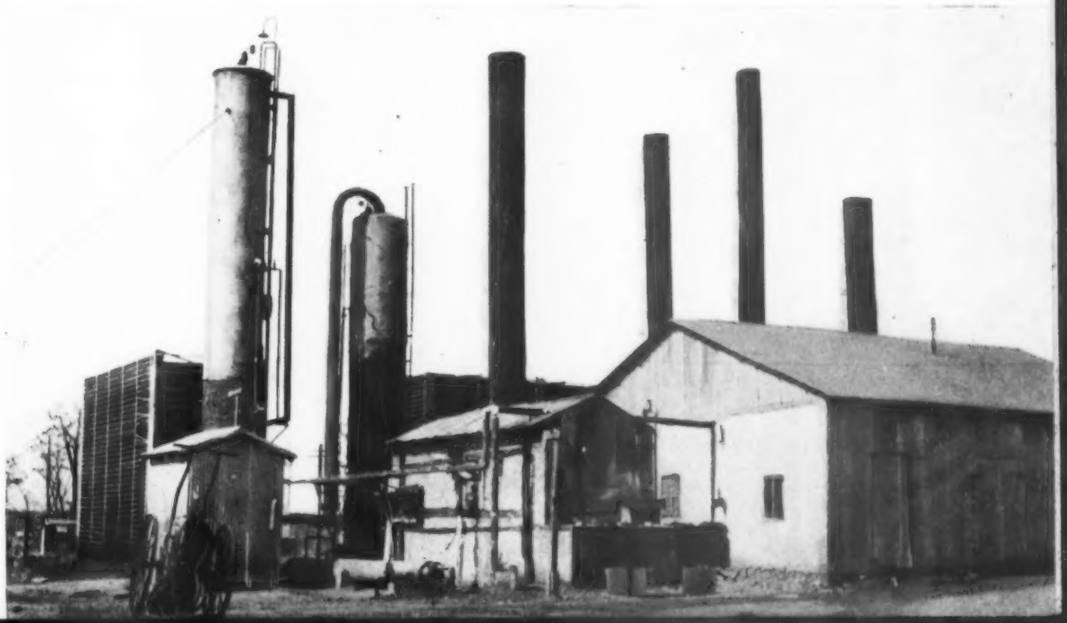
He paused at the radiator forming a part of my hiding place, rasped a match against metal. I nearly strangled trying to choke back the cough as he blew a cloud of pipe smoke seemingly right at my face. Then the place was in darkness, and I waited only until the sounds from the house failed to re-echo down the passageway before I crawled, seemingly in disjointed sections, from my covert.

One of the four regular tank covers had been replaced on the salt water truck, the new one carrying an air hose attached to an extension from the relief valve, a wire-wound gasoline hose screwed to the other fitting. Still groping in the dark, I opened the air valve slightly, and was rewarded by a trickle of water, brackish to the taste, from the big hose. Air under pressure, admitted through the smaller hose, was being used for forcing salt water from the tank through the other hose.

I was one step on my way! The Lombard-Howell garage was serving as salt water transfer point.

It took all of an hour, working in the gray darkness of the foggy night, to rig a matchstick trip which would operate as I closed the

Type of tea-kettle refinery that merely skims the rich crude, here today and gone tonight, offering the readiest market for hot oil.



doors from outside to allow the heavy bar to fall in place and thus cover my escape. At last it worked and I slipped outside, heard the dull thud of bar in crotch, tested the doors for tightness, and set off across country for the little settlement straddling our gasoline line.

Howell's truck was just leaving his lane as I trudged up the branch road toward my boarding place. There was a sudden glare as the spotlight played on me, but I had stopped at a convenient slush-pit, and was as smeared with oil and dirt as any roughneck returning from the graveyard shift should have been, and the truck continued on its way.

In the morning I beat the office to it with my forecast that the night's shipments would again contain salt water—and was not surprised when two cars checked short by the usual 400 gallons of salt water.

Personally more than convinced that somehow Howell was trading the salt water for gasoline, I must get proof. Cadging a small phial of methyl orange from our chemist, I haunted Howell's truck. From the relative positions of the two tanks in the Lombard garage, I figured the transfer could have been made only through the second opening in the fresh water carrier. At last my chance came. With pliers I unscrewed the cap from the relief valve on the tank top, poured my two ounces of liquid into the tank.

At the office, I reported that the next salt water coming from our line would be tinged with the bright color of the indicator I had used.

Notwithstanding my assurance, it was as heartening as a bonus when the receiving refinery's chemist reported enough indicator liquid in the salt water to confirm my prediction.

On the strength of that the company dug up its line through the settlement. Howell had burrowed to our line from the offset section in his well casing in which he later set his pump. Not once, but twice, he had tapped our line. The first entry came just short of the top of the rise, the other just beyond. The two hoses he used were tied in to a system whereby salt water from the second compartment of his tank would flow into our line just past the hump, while gasoline was forced by our plant pumps through the other and enter the same tank space.

If our pumps were down, the difference in specific gravities of salt water and high test gasoline would unbalance the system and thus the tank would automatically exchange its salt water for gasoline.

With the by-pass unearthed, we seized the truck and discovered a most ingenious series of check valves on the pipes within the tanks to make detection difficult, as fresh water would flow from any of the four faucets if opened, the salt water being handled through one of the lines by manipulating a three-way valve hidden within the truck frame. The illegal cargo of stolen gasoline in the second compartment could be unloaded only by siphoning, and thus there never was a trace of fuel to contaminate the water and thus betray the plan.

BLACK MAGIC AT THE CROSSROADS

Development of an electrical tester which, merely carried above any pipe, would unerringly indicate the presence and exact location of any line tied into the one being checked, enabled the office to determine easily many illegal connections, and greatly cut down former losses through this means.

Howell had circumvented this detector by using heavy hose for both pump and gasoline connections and then, as an extra precaution, had laid a network of small lines from his supply tank to his garage and garden.

As we became adept in spotting illegal by-passes and tie-ins, the pipeline thieves were forced to fall back upon existing conditions and connections, and in so doing sometimes displayed a degree of ingenuity worthy of better aims.

At entirely unpredictable intervals another of our field lines began checking up a full 500 bbl. short. By gradual elimination, the loss was located as being in "B Section" of our field gathering system, a gravity-operated gridwork of lease lines tying at last into an eight-inch main serving as suction feed for a field pump station. Hourly runs through this section varied from a few barrels to as high as a thousand, but repeated flow checks against times of recorded shortages ruled out my final postulate—that the gravity or flow pressure was enough to force a portion of the day's run through some check valve and into another line.

Night after night I haunted the section, working with the field gaugers as they put on or took off a lease tank battery, and twice in one week when my sunrise report at the office was "all quiet", the retort was "Yes, to the tune of a 500-bbl. crude loss!"

With our "gangpusher", or field pipeline gang foreman, I went over all the connection data, verifying every change from the original material sheets on file in the office. The line, fed by branches diverging toward the various leases, was equipped for air venting. This meant that each incoming branch carried a check valve as close as possible to the main stem, so as to force any entrapped air to work back into the head-of-line tanks for release there.

The presence of these check valves seemed to guard against any back flow through the line but, with recollection of X.P.D.'s drilled gate valve to shake this assurance, I broached the question of digging up and examining all checks against tampering.

My suggestion was countered by proposing a simple test: if any check had been tampered with, the lease line it protected should become air bound if a slug of air were introduced into the drainage end of the closed system. When tried, none of the lines save the main stem, designed for its removal, showed so much as a bubble of air.

Silenced but not convinced, I backtracked the entire gravity system with our electrical tester, finding absolutely no trace of any tie-in, tap or branch line—which might have meant, again, that rubber hose was being used to flow away the stolen oil—but which I interpreted to mean that some existing line had been altered so as to allow the diversion.

The problem ever before me, I drew up a profile of the system under investigation, and found that there was sufficient gravity head in the upper tanks to force oil clear over the tops of the lease batteries lower down. Here, again, the checks should have protected us, but nevertheless I rechecked with the electrical device all flow lines from tanks to our system, again failing to find any tap or outlet through which the oil could be diverted.

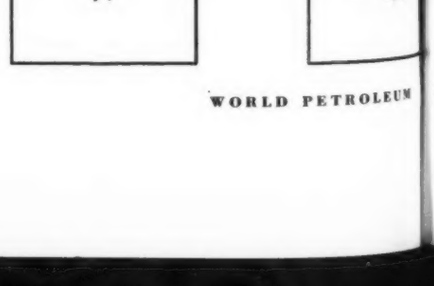
Checking gaugers' run tickets for a possible hint, I was struck by the fact that the top gauge on our own Zarepta lease tank read the same figure, to the quarter of an inch, so often that the law of probability covering coincidences was stretched 'way past the breaking point. Noting this, I asked for the field gauger's job, but was no more successful in discovering irregularities than had been my predecessor.

The switcher or tender on Zarepta lease, as were many of the field workers in East Texas during the lean depression years, was a university man, an electrical engineer. Gradually he had acquired the necessary equipment for a small electric welding shop, locating it where the lease property abutted on the main highway. To provide entry he had, with our superintendent's permission, filled in earth to form a roadway which, as it happened, buried our gravity line a good four feet deeper at that point.

I had spotted the fill early in my investigation, to "happen" that way with the electrical tester numerous times, but the fill checked as void of betraying indications as did any other part of the extensive system. Then, gauging off the lease one dawn, I noted that the temperature of what little oil remained below the outlet nipple had dropped almost 20 degrees during the night.

Checking back on lease records, I found that the full tank, of crude oil fresh from the well, frequently but at irregular intervals showed a wide spread between opening and closing temperatures—and that weather conditions did not justify such a variation. Further checked against other lease records,

H—Howell's fresh-water truck tank, L—Lombard's salt water truck tank, A—airline compressor, K—hose carrying salt water to Howell's tank, N—nipple measured to stop transfer of water before overflowing Howell's tank.



Strung along every open lane, these cabins spell home to the oil-field worker until the field . . . or the job . . . or the roof . . . plays out

it began to appear that I had at last pinned the trouble down to Zarepta lease, and that there must be some connection between the coinciding of full gauges all on one reading of the tape and the excessive temperature drop.

As I became more familiar with the gauger's round, another and apparently unrelated fact gradually impressed itself on me: the electrical generating system of the little shop seemed to be doing lots of night work, and when I mentioned this to the switcher he merely grinned and shrugged.

"Why not," he came back at me, "with the gas for the engine costing me nothing—it's cheap lighting current for shop and shack."

That got by, until I observed that the instruments on his panel failed to fluctuate as much as I thought they should with the making of an arc during welding. Then one night I noted that the converted automobile engine driving the generator was, by the bark of its exhaust, carrying more of a load than could be explained by the few lights in the circuit.

On impulse I back-tracked to the lease tank, got a snap gauge. The oil level had dropped but a scant six inches, but the oil in the tank had cooled 24 degrees since being put on the system, only three hours earlier!

As I passed the welding shop en route to my car, I caught a softer purring note to the engine. Reaching into the back of the car I fished out my portable telephone set, scaled the nearest pole of our lease communicating system, and—the switcher hovering at the base of the pole—finally roused the district gauger.

"It's a break," I shouted, needlessly, "on our gravity line—no, Brown lease. I'll meet you and the gang at the road into Zarepta."

The Brown lease lay adjacent, but when the gauger and a hastily recruited labor gang showed up I unloaded them at the corner.

While the switcher looked on from his shop door, the men grabbed tools and at my indication began to dig into the earthen fill. Before the trench was knee-deep, however, the man slipped within his shop, cut off the power, and disappeared in the darkness toward his shack.

Fifteen minutes later we uncovered the check and learned what, if I had known it or the gangpusher had thought to inform me, would have materially shortened my search—the check valve body on the Zarepta line was of brass. Positioned directly atop it, but completely masked by the fill, was a powerful electromagnet, energized by the welding generator. We did not need to lift the cover to guess that the original brass valve had been replaced by one of iron, nor to demonstrate the lifting power of the magnet to understand how the switcher, with his device, was able to open the check valve electrically. He would simply throw a switch in his welding shop, after which oil in the gravity system would flow whichever way the higher pressure dictated.

With the check valve uncovered, further investigation showed that the man had tapped into the flow line between separator and well so that when the lease tank was run full of oil from our gravity system, the excess would siphon back into the normal flow line, enter a second tank of 500-barrel capacity on an adjoining lease and through that find its way to a "hot oil" refinery a mile away.

The uniform opening gauge marked the times of oil theft, the oil level after thus using our lease tank as a link being that at which the suction through the inflow line would break when its supply was cut off by permitting the check valve to close properly. The temperature change was caused by the fresh oil, still warm from the well, being replaced by that flowing through the gravity system from tanks where it had stood long enough to have cooled to atmospheric temperature.

Needless to state, the shack was empty when the hastily summoned deputy sheriff went to get the switcher. Comparing notes, quite unofficially, with an ousted executive of the refinery, it developed that the switcher had received 35¢ a barrel for the oil he had run them, or a mere $175.00 a night—ample pay for the current he had generated.

PERFUME OF CAPITAINE LECHAT

I had just packed my toothbrush and an extra pair of socks for a pipeline engineer's outing when the house 'phone rang. My vacation must be postponed; instead I must go to the Gulf Coast, rent a boat, and see what I could find in the vicinity of the gasoline line linking our refinery to seaboard.

Somebody, it appeared, was swallowing from 1,500 to 3,000 bbl. of gasoline at a gulp, and doing it so neatly no trace was left. The amount being taken limited my search to water. No one could hope to load up to a dozen or more tank cars with stolen gasoline and get away with it, but with a tank lighter or barge—

A survey of the terrain traversed showed three possible areas in which the thief might operate: he could tap our line where it traversed the shallow bay, never more than 30 ft. below the surface; or at either of two river crossings, both these being well wooded and offering excellent concealment.

We pumped through our line on an average of three times a week, and as it was possible simply by the pressure shown at any tap to determine whether or not the pumps were in operation, the line-tapper had at least every other night in which to work without his opening of the line being recorded at the nearer end of the 200 miles of eight-inch pipe. Due to the difference in elevation between refinery and coastal tank farm, the gasoline within the line would flow under gravity, even if the pumps, used to quicken flow, were not in operation.

Although watching the rivers in preference to the bay had been suggested, it seemed to me that the latter was a more likely area in which to operate. To prove this, I closed each of the rivers off effectively—so far as the undetected passage of any craft drawing more than three feet of water was concerned—by stringing a weighted fish line below steamlined floats in an arc entirely crossing the navigable portion of each river.

When both detectors remained intact after the morning check-up at the tank farm had revealed the loss of 2,000 bbl. of gasoline since the last pumping, I concentrated on the

bay, paddling aimlessly into one bight after another, but always returning to draw my craft ashore and invert it for shelter near the warning pipeline crossing sign, there to bathe liberally with oil of citronella and, night binoculars at hand, try to keep awake, try to fend off the hordes of voracious insects, and try to spot a motionless craft in a slowly eddying drift of misty vapors.

All through the dark of one moon I haunted the bay vicinity where our line went to sea—with nothing but an ever-increasing pattern of gigantic welts from mosquito bites to show for my vigils.

Again checking with the office, another gasoline loss was reported, and I went back to my lines across the rivers, finding both intact.

During the moonlit hours I trailed a fishing line from the bow of my canoe, and strove to put myself in the place of the man who was getting away with so much of our gasoline. Because the bay seemed to offer the most opportunity, I found myself doubting its use by a really clever thief, and went back to recheck my river blocks.

Finding the lines again intact, I let the long string of floats again bob in the roily waters, and paddled to shore to examine the end there. The thin grey line was mine, but —I looked closer, holding flashlight beam steady on the knot—the tie where the end encircled a willow wand at the water line was *not* mine.

At first glance appearing to be a bowline, my knot differed from the true bowline in that I passed the end across the twist and then around the standing part, while the knot at which I stared had the end passed first around the standing part. Somebody had carefully untied my line and then replaced it. I had now progressed to where I could say that a sailor had evaded my detector by removing it, and had been at great pains to replace it.

Transferring my base of operations, I spent two nights swimming and diving, working outward from each shore along the pipeline, groping with hands and toes in the sandy muck of the river bottom for the bleeder which, I was convinced, must lie there somewhere. At last I found it, a heavy three-inch steel armored rubber hose, thirty-odd feet long, a valve closing the end away from the pipe.

Reporting the leak would help little. If removed it would be only a question of time until the thief would again tap the line, and the job would be to do over. To end the trouble I must catch the man and his craft in the act of stealing gasoline.

Perhaps I was a little careless, or maybe some of the natives thereabouts were in league with the line tapper, for the entire next period of the moon's darkness passed without a loss.

Then I shipped my canoe back to the friend in Houston from whom it had been borrowed, and cleared out—only to return at midnight with a recording gauge over which I had worked hopefully. Tapping into our line a quarter of a mile from the river, I connected in the gauge and set a contact so that the recording pen of the instrument would meet it and close a circuit for a period of 20 minutes, thus effectively grounding our pipeline telephone system, if the static pressure on the line dropped—as would be the case if the three-inch hose were used while the pumps at the refinery were idle.

Tank trucks as innocent-appearing as this one carry all kinds of contraband and unlicensed cargoes for the motorized pipeline pilferer.

Four nights later, in the dog-house at the delivery end tank farm, with rain beating at the windows and lightning crackling constantly, I heard the line go dead. It took an hour to cover the twenty miles of local road to the river where, in a battered rowboat I had handy, I began to work down to our pipeline crossing and the looting craft I was sure must be anchored over it.

At last it loomed before me and I pulled in my oars, huddled below the gunwale as I drifted, all but blinded by the fury of the rain beating in my face. Lightning flashes showed a square bow, held to the current by a tugging mooring line, and I inched my anchor into the water, snubbing downstream progress until I held the boat almost even with the stern of the barge.

Shifting the hitch of the anchor line from the bow aft as far as the forward oarlock, I was able to use the current force to swing me nearer the craft. Still I could not read name or hailing port on the broad, squat stern. Another flash of lightning and I understood—a tarpaulin, ballooning in the wind, had been draped over the identifying marks to forestall any chance recognition.

Untying my anchor line, I strove to work my water-logged boat nearer, swinging in maddeningly slow arcs to and fro with the current, but never able to close the gap. Then came another blinding flash of lightning, an answering burst of reddish flame near the tiny wheelhouse of the barge, and something struck my shoulder with tremendous force. I was lifted clear of my boat, the taut anchor line dragged through lax fingers, water roared in my ears and burned within my throat and, the next I knew, I was restlessly tossing on a hospital bed, and trying to figure how it had been reached.

On this last the white-garbed nurse could tell little. I had been brought in by a motorist who had disappeared almost before the litter bearing my bedraggled body had been wheeled to the elevator. I was a good fifty miles from where our line was tapped; and there was a bullet hole through my left shoulder which seemed to take most of a bale of cotton every time it was packed, and which should have made it impossible for me to keep afloat, much less to have reached shore and stumbled to some highway, there to be found by my anonymous rescuer.

My first thought was to report to the office, my second to lie low and try to devise some way to outwit the bargeman. The skunk, the low-down skunk—and as I so thought of him my plan took form. While I convalesced I worked out the approximate amount of gasoline to fill our line from refinery to where the hose was connected.

At last, free of my bed, and not daring to risk vetoing of my plan by reporting in person, I called the office by 'phone and after hanging to the line and sticking to my scheme for half an hour, carried my point. Then, timing the pumping so that 48,000 bbl. would be delivered through the line and my preparations completed two days before the next new moon, we shut down the pumps and waited.

Two days later angry complaints began to pour into our tank farm from the district. The self-propelled barge "Bayou Belle", which distributed our gasoline to local points on the inland canal system, was putting out some gasoline which literally and putridly stunk.

Even the exhaust from the gasoline engine propelling the "Bayou Belle" was malodor-

ous. With the pungent breeze to back me up, I placed my evidence before the company: the bargeman, our accredited agent in the district, was tapping the line and making not only the legitimate profit on resale, but also clearing the entire take on stolen amounts.

Buying enough of our own gasoline through the tank farm, he was protected against discovery through sampling his cargo, until I prevailed upon the refinery to mark one day's run of gasoline and time the pumping so it would arrive at the site of the loss at the proper phase of the moon. The mercaptans, ill-smelling sulphur containing hydrocarbons which the refinery is at much pains to remove from its output, were added in concentrated form to doctor the gasoline and be unpleasantly evident to anyone attempting to burn the mixture.

On the strength of the mercaptan concentration in the gasoline found in his barge tanks the bargeman, Captain LeChat, was arrested and brought to trial, conclusive proof of his guilt being clinched by demonstrating that the bits of brass thread held within the end of the iron valve on the hose end had been stripped from the tip of the filler line on the barge "Bayou Belle."

Paroled before the ink on his commitment was hardly dry, not even his powerful political friends could stifle the wildfire spread of the name by which Capitaine LeChat became known behind his back. For "M. le Capitaine Putois" of the Creole translates readily to "Captain Skunk," which is how I thought of him as I lay abed in the hospital and devised the plan to stink him out.

VENEZUELAN GEOLOGICAL CONGRESS By C. N. Clark

AN EVENT of unusual scientific interest, related especially to the study and investigation of Venezuela's vast petroleum deposits, is the assembly of Venezuela's first Geological Congress which convened at the city of Caracas on February 15th.

The inspiration for this Congress, and the prime mover in the studious preparation for it, belongs to Dr. Guillermo Zuloaga, and his associates of the Geological staff of the Ministry of Industry.

Dr. Zuloaga has long felt the need for such an interchange of scientific opinions and the acquisition of technical knowledge with respect to Venezuela's geological structure, as could be brought about by a Congress which should bring together the men whose study, both within and outside of the country, have made them especially qualified to impart useful information.

He has felt also that although Venezuela is one of the countries which has been most carefully studied by competent geologists, nevertheless the results of the greater part of their work have remained unpublished. Thus the student or the geologist newly arrived within the country finds but little information as the basis for his further study or work. This first Congress therefore, is designed to give publicity to the results of years of methodic and detailed study of the country's subsoil, by geologists of recognized ability — men whose labors have been crowned by a success which has placed Venezuela in a foremost position in the world's production of petroleum.

The Ministry of Industry of Venezuela invited the cooperation of the technical departments of the petroleum and mining companies as well as the assistance of members of the profession within the country and from abroad, and the response has been most cordial, attested by the participation today of representatives of the technical staffs of the principal petroleum companies operating within Venezuela and of numerous international experts.

The Congress was opened on February 15th by the President of Venezuela, General Eleazar Lopez Contreras, who extended a national welcome to the members and delegates. He was followed by Dr. Nestor Luis Parez, the Minister of Industry, who outlined the purpose of the Congress and declared it duly opened. The Congress organized by electing Dr. Pedro J. Aguerrevere, as its President. Dr. Aguerrevere is a graduate of the University of California, and is an engineer of the Department of Public Works of Venezuela. The attendance was large and enthusiastic, embracing both native and International scientists. The following program outlines the subjects for discussion and the men who will present the results of their study:

MONDAY, THE 15TH. Geological data relative to the Central region of the Coastal Cordillera; Dr. S. Aguerrevere and Dr. G. Zuloaga. Contribution to the Geology of Venezuela's Southwestern Andes; Señor Victor Oppenheim.

TUESDAY, THE 16TH. Observations respecting the Cretaceous and Precretaceous Beds of Western and Central Venezuela; Dr. L. Kehrar. Synopsis of the Formation of the Western part of the Maracaibo Lake Basin; Señores H. Hedberg and L. C. Saas. Eocene of Bolivar Coastal Fields and their Paleontology; Señores N. W. Haas and R. G. Hubman. Stratigraphy of the Mene Grande Area; Señor G. E. Tash.

WEDNESDAY, THE 17TH. Geology of Some Area about Mene de Buchivacoa; Señor G. N. Halse. Notes on the Formation Punta Gavilan in eastern Falcón; Señor H. N. Suter. Geology and Stratigraphy of the Cumarebo region, state of Falcón; Dr. Gonzalez de Juana. Comparison of Maracaibo and Maturin Sedimentary Basins; Dr. C. Wiedenmayer.

THURSDAY, THE 18TH. Stratigraphy of the Quarecual section of Northeastern Anzoategui; Hollis D. Hedberg. Geological Section in the Parinas Area; Mr. A. N. Mackenzie. The Great Mamiferous Fossils of the Barquisimento Region; Señor H. Nectario Maria. The Quaternary Rocks of the Region of the projected Macarao Dike; Dr. W. Grenouillet.

FRIDAY, THE 19TH. The Congress will proceed to the town of San Juan de los Morros, in the state of Aragua, and on the following day will study the extremely interesting geological region from San Juan to Ortiz, returning to Maracay.

On Sunday, the 21st, the members will make an excursion about the lake of Valencia, breakfasting at Rancho Grende on the high slopes of the Cordillera and returning to Caracas. On Monday, the 22nd, will be held the closing session of the Congress.

En route on the Trans-Caucasian Railway—a train-load of Baku oil rolling toward the refining center.

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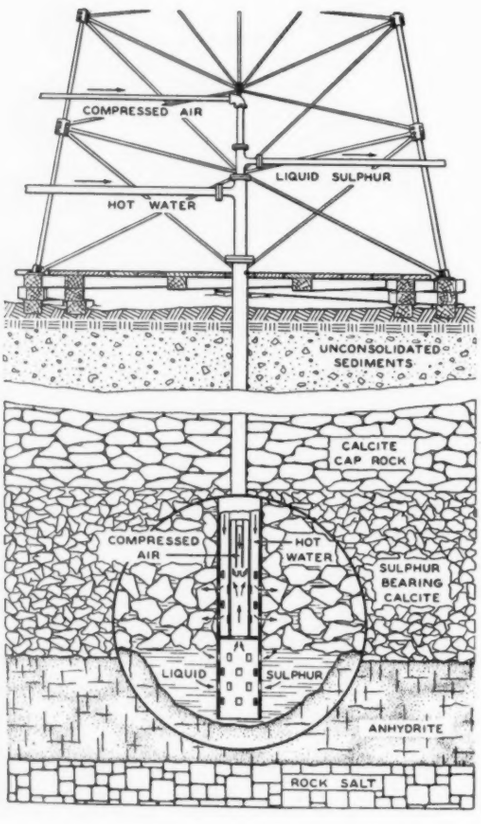
MOLTEN SULPHUR—An Experimental Circulating Fluid

Use of Sulphur as a Circulating Fluid, Now in Strictly Experimental Stage, May Prove Useful Future Development in Drilling Heaving Shale

A TEST well has been drilled at Boling Dome in Texas using molten sulphur as the circulating fluid. Eight-inch casing was set using the "frozen" sulphur as cement, and the casing was subsequently recovered by re-heating the cement.

The well went to a depth of 750 ft. with standard rotary tools, except that centrifugal pumps were used, though only because they were available and not because of characteristics of the fluid requiring special pumps. The only special equipment used was a steam coil in the "mud" pit and a section of casing rigged to circulate steam to pre-heat the drill pipe before running in.



Illustrating the piping and hook-up for the production of sulphur that may in future be used as a circulating fluid for oil well drilling.

Under some conditions the limitations and drawbacks of muds and weighting materials presently available have long stimulated rotary operators to consider other fluids that might be used. Petroleum engineers in the Southwest familiar with this Texas Gulf Sulphur Company's test well stated in interviews they were interested in the possibilities molten sulphur appears to offer and that it is a development to observe closely as further tests are made. One or another of the major operators in Texas is expected to try a well of normal depth in the near future.

The first questions that come to the mind of many are: "What is sulphur likely to accomplish?—What are the difficulties and hazards in using it? What are the costs and proposed technique?"

As a circulating medium it appears to promise aid in conquering many cases of heaving shale and unconsolidated formations. If the proposed method is successful it would solve a drilling problem in the case of caving sand or gravel by consolidating these materials into a solid mass to any reasonable radial distance necessary to provide the required wall strength. With heaving shales the solution, again if successful, is presumed to be both physical and chemical. In other words infiltration of the shale walls with molten sulphur would not only displace moisture there and replace it with an insoluble cementing medium of greater strength, but would also eliminate the cause of "heaving" of the shale—*swelling—by sealing off water in the drilling fluid, and preventing it from entering the shale.

By heating the hole properly the fluid can be forced well back into these formations—a uniform 12-inch penetration of wall was secured in the test well, and penetration of several feet in certain shales and caving sands seems entirely possible—where it is allowed to freeze, and produces an impervious supporting wall approaching the strength of cement. As this penetration occurs whether or not moisture is present and as the weight of fluid sulphur is 15 pounds per gallon (115 pounds per cubic foot) it may also prove useful in controlling certain high pressure water and gas zones. If it is desired only to use a supporting sheath of sulphur during drilling operations and with minimum penetration losses, it can be mentioned that this was accomplished on the test well by using a collapsible bit and temperature control which allowed a two-inch wall of sulphur to solidify during round trips.

The advantages claimed for sulphur as a cementing agent will be apparent from the above. A perfect seal would be obtained by penetration of the formation, plus the seeming impossibility of channeling back of the casing. Sulphur under well conditions would prevent corrosion, and as an insulator has somewhat greater electrical resistivity than mica or bakelite. As there would be no corrosion and probably no pinching because of the surrounding supporting wall, complete recovery of casing and some of the sulphur would be only a matter of reheating the hole. A point of passing interest is that in a hole filled with fluid of density 1.8 increased buoyancy would add considerably to the theoretical length of casing string that could be run, assuming some provision were made to compensate for its shrinkage during cooling.†

In the way of hazards a Texas Gulf official has pointed out that molten sulphur at 250 to 300 degrees will be inherently dangerous to personnel when handled at the pressures common in oil well circulating systems. A burst connection or hose on a derrick floor is a picture to which little can be added. It is obvious that careful preparation and operation of equipment will be essential.

The principal mechanical hazard in the use of sulphur raised by most engineers is the possibility of a break-off that might permit the tools and lower part of the hole to freeze up before circulation could be re-established. This appears likely to remain an inherent risk but not an unacceptable one under all conditions and some provisions might be made to ameliorate it.

H. L. Reed, development engineer in Houston, credited with origination of the method, believes that since the sulphur is an excellent insulator and the drill pipe would be completely encased in it except at the face of the bit where there would be contact with formation not yet impregnated, it would be possible to establish contact with the fish and re-heat the hole electrically. Electrical men counter that under most field conditions there would be no practical means of getting enough current into a long string of drill pipe to accomplish this.

A point raised is that the heat losses in a sulphur-filled hole are small, and that cir-

*A chemical and physical equilibrium is disturbed when rotary mud is circulated through shale. The swelling of the shale is the result of reaction between silica of the hydrous aluminum silicate (bentonite) and the lime and free water in drilling mud which combine to form a highly hydrated calcium silicate or calcium aluminum silicate, resulting in rapid disintegration of the shale due to removing its natural bond or cementing agent. The colloidal method of meeting this problem is only partially successful.

† Wm. H. Geis, Los Angeles engineer, has long proposed the use of asphalt as a cementing agent.

An idea of the huge quantities of sulphur available in the southwest is conveyed by the above illustrations. On the left may be seen molten sulphur being discharged into a storage reservoir, showing the liquidity of the sulphur under proper heat conditions.

culation could be down much longer than might be expected without freezing the hole except near the surface. As soon as a coating of solidified sulphur forms on the walls of the well, the heat insulating properties of this coating rise rapidly, and conserve the heat in the fluid core. Some indication of this was furnished by the test well, where the difference in input and output temperatures is said to have amounted to only 5 deg. F. (315 deg. to 310 deg.) during the circulation cycle at 150 gallons per minute.

Problems of heating, handling, pumping, etc. all appear to be too easily met with equipment ordinarily available to go into in detail at this time. More boiler capacity would have to be available. Rubber pistons in circulating pumps would be unsatisfactory, though no substitute for ordinary rotary hose seemed necessary. The most useful temperature/viscosity range is indicated as 235 deg. to 260 deg. F., safely under sulphur's boiling point—500 deg. F. It is inert, insoluble in water, oil, acid, or bases, and at the temperatures employed any water returning with the sulphur would flash out. Cuttings settle out quickly in the pit.

ESTIMATED COST

If handling difficulties do not develop in wells of greater depth, nothing in present estimates would preclude the use of this material on the basis of its cost and in some cases a marked economy is indicated. Sulphur sells for about $20 a ton in Texas. In this service royalties could be expected to add 10 percent. In getting through 2500 ft. of heaving shale from 5900 to 8400 ft. in Calhoun County, Texas, the Hiawatha Oil Company is said to have spent over $15,000 for Baroid, Aquagel, and thinning agents, which is $6.00 per foot. At the rate of penetration experienced in the Sulphur Company's test well, cost of sulphur to get through this zone would amount to only $3.50 per foot, and this would automatically include the cement job and facilitate removal of the casing.

PROPOSED TECHNIQUE

Petroleum engineers interviewed in Houston and Dallas suggested that the ultimate development may be the alternate use of bentonite fluids and molten sulphur at various stages as drilling progresses. In any case the proposed technique does not necessarily contemplate the continuous use of sulphur, and almost surely not the use of sulphur after penetration of the oil zone in known fields.

The suggestion is made that sulphur only be introduced when a heavy fluid is needed, instead of weighting the previous mud. The procedure would probably be first to preheat the hole by means of a steam coil in the slush pit, then cut the suction line over to the sulphur melting tank and continue circulation until the mud was displaced.

Drilling would continue, preferably with a collapsible bit, until the sand was reached, where the oil string would be run in the sulphur and allowed to freeze. Completion in the oil sand might be made with Otis or Gray Tool methods.

SECOND WORLD PETROLEUM CONGRESS

To Be Held In Paris

Geology, Drilling, Physical Chemistry and Utilization Will Be the Main Sections to be Covered at Paris Congress Being Held Simultaneously with International Exposition

THE Second World Petroleum Congress organized by the French Association of Petroleum Technologists (A.F.T.P.) will be held in Paris from June 14 to 19, 1937. The provisional program of this congress has now been published in Paris and will soon be available in English at the Institute of Petroleum Technologists which will be remembered as the body that organized the first World Petroleum Congress held in London in 1933.

The inaugural session of the congress will be held on Sunday afternoon, June 13 and sectional meetings will be held in the mornings of the following week at the Maison de la Chimie, 28 rue St. Dominique. The scope of the papers to be presented at the Congress is indicated by the headings of the five main sections.

1. Geology and Drilling.
2. Physical chemistry and Refining.
3. Equipment and Construction.
4. Technology and Utilization.
5. Economics and Statistics.

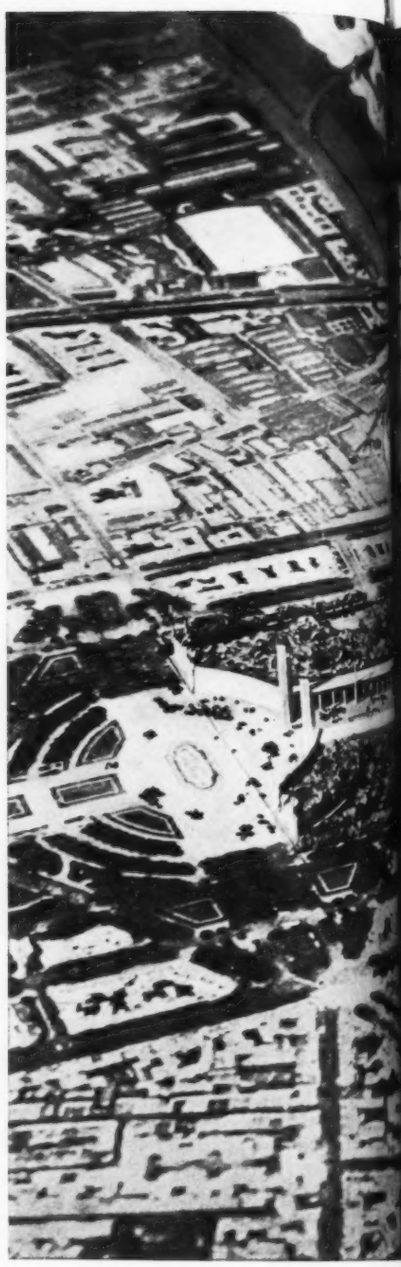
Colonel Louis Pineau, Director of the Office National des Combustibles Liquides, has accepted the position of President of Honor. Ch. Bihoreau, former president of the A.F.T.P. and Secretary of the International Drilling Congress held in Paris in 1929, is president of the Second World Petroleum Congress.

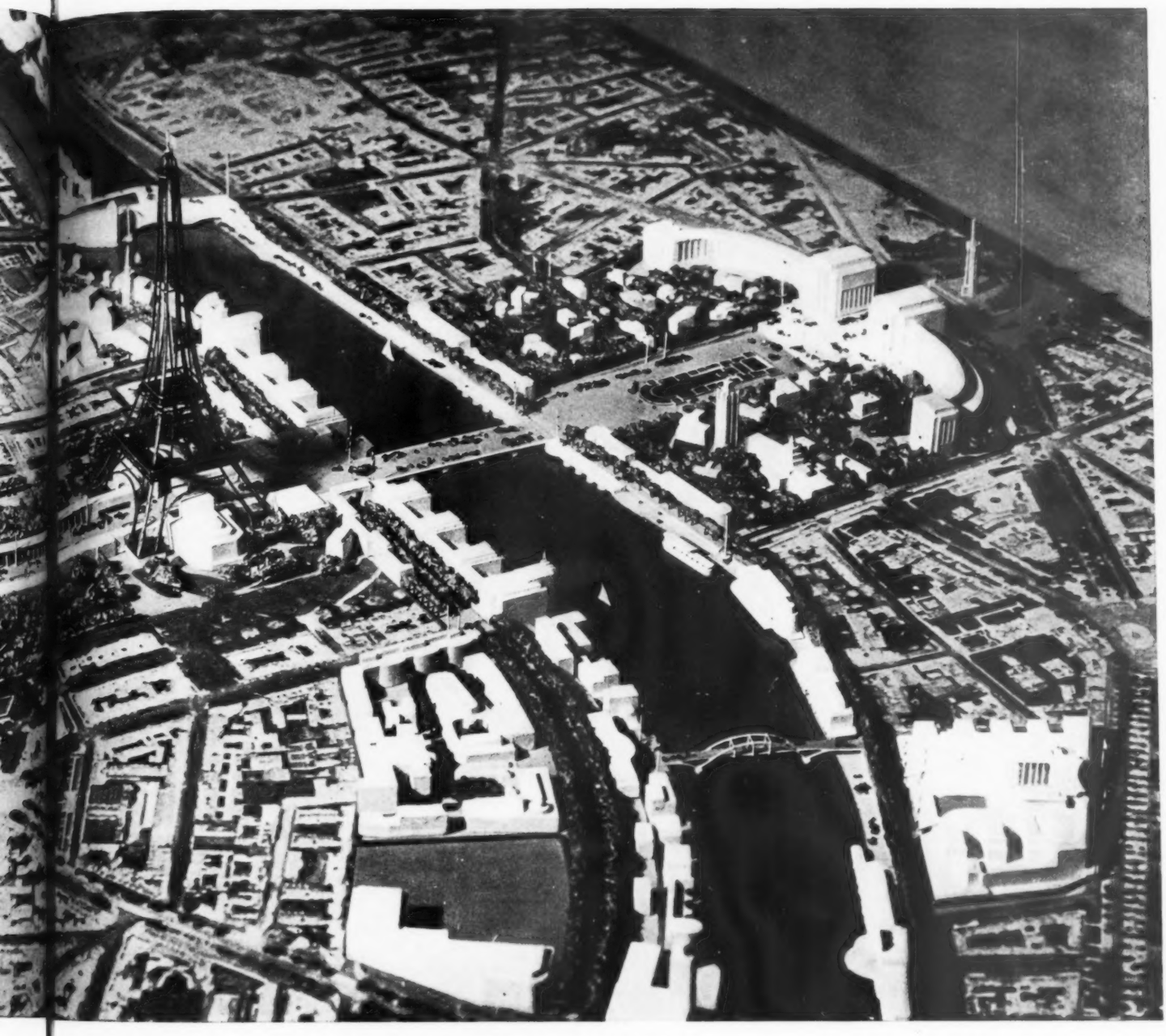
A large number of technical contributions have already been received and will be presented before the five sections referred to above. The papers will not actually be read, but copies will be presented to those who attend the congress and discussions of the various papers will be permitted in the meetings. It is expected that a large number of American oil men, many of them accompanied by their families, will attend the congress to be held in Paris, particularly in view of the Coronation ceremonies being held in London just prior to the exposition and the attraction of the Exposition Internationale which will be held in Paris at the same time as the second oil congress. Those who attend the congress will receive a free ticket to the exposition. A number of extremely interesting tours have been arranged to enable oil men to visit refineries, producing and marketing centers in Europe and France. One of the tours arranged by the association lasts for 15 days starting on the 28th of May, covers Morocco, refineries in the south of France, and extends as far as the oil field of Djebel Tselfat. Other tours take members to northern and eastern France, to the Seine Valley and the district of Bordeaux. In addition to these formal tours arranged by the association a group of mid-continent oil men are planning an extensive tour leaving Paris directly after the congress and travelling to the refineries in the South of France, the oil fields of Italy, through Austria to Roumania and back to Paris by way of Germany. Details of this tour may be secured from the editorial office of World Petroleum at 56 W. 45th Street, New York. In view of the fact that this group plans to travel from New York to Europe on the French Liner, NORMANDIE, that ship will be in a sense the official trip to the congress, sailing from New York on June 2.

American participation in the congress includes a committee formed by the American Association of Petroleum Geologists and a committee headed by Dr. Gustav Egloff which will take charge of that part of the program devoted to refineries. Some 25 notable American technologists have already offered to prepare papers on various phases of refining.

One of the important subjects to be taken up at the second World Petroleum Congress will be questions of international standardization. Committee of 28 of the International Standards Association has been recognized as a medium for international cooperation on petroleum standardization matters. It is obvious that a great deal of work has yet to be done on commercial standardization for the petroleum industry and it is to be hoped that the committee will be able to make some progress in this work at its meeting at the Paris Congress.

Commercial standardization of the petroleum industry has not yet been achieved and the leaders have not elaborated a code which will permit of international understanding. It is almost impossible now to make comparisons of figures upon petroleum data in various countries. Units of measure, density, and tonnage vary with each country. In the United States the unit is the 42





Paris, site of the Second World Petroleum Congress to be held during the International Exposition in June. The Congress will attract petroleum technologists from all parts of the world.

gallon barrel with a capacity of 159.19 liters. Each U. S. gallon contains 3.785 liters. In England the imperial barrel is the same size as the U. S. barrel but contains 35 imperial gallons. In France the metric system is used but the customs are based upon weights and volumes, i.e., quintals and hectoliters. The specific gravity of the products is not indicated and it is not possible to establish a common measure which will allow accurate addition. Even if densities were given it would be difficult to make exact comparison because the methods of taking densities are varied. Roumania gives statistics on oil production in tank cars of 10 metric tons and Mexico uses cubic meters, etc.

The same problems arise with questions of tonnage. Marine transport has a tendency to use the term tons without further explanation although the net ton is about 40 percent less than the gross ton, etc. A common language would be of great assistance to the producers, importers and statisticians. The metric system has been suggested as supplying the necessary common unit of understanding.

The economic section of the congress proposes to cover the history of oil including its use in navigation, war and medicine. The main contributions to this section will, however, deal with present day economic questions involving production, distribution and utilization of oil. One extremely interesting aspect of the economic section may deal with the relationship of oil companies to governments, a consideration of various petroleum laws and a discussion of government participation in oil companies and government monopolies.

Foreign Oil Legion

B. P. Newton.

B. P. NEWTON, Vice President of Gulf Oil Corporation in charge of export, is on a two-month's trip to Europe looking after the affairs of the company in European markets. For several years Mr. Newton was stationed in Antwerp and a signal honor recently was paid him by the Belgian government; the King of the Belgians conferred on Mr. Newton the decoration of Chevalier de l'Ordre de Leopold, the oldest and highest decoration within the gift of the government. The order was created by Leopold I, first king of the Belgians nearly 100 years ago. It is conferred only for exceptional service and very rarely upon citizens of other countries. The bestowal of this honor indicates in a striking manner the extent and significance of Mr. Newton's services to Belgium.

DR. FRANCIS D. BODE, of the California Institute of Technology geology staff, left Pasadena February 15th with Mrs. Bode for a lengthy stay in Southern Europe. He has been granted a two-year leave of absence and will make his headquarters in Italy. Dr. Bode expects to study many of the famous geological formations of Europe, especially those in Austria, Italy, and the Alps, which geologically are among the most interesting and complicated in the world.

During the past three years Dr. Bode has spent much time in Mexico doing field work for the California Institute of Technology. While in Europe he may meet his former colleague, Dr. John H. Maxson, who has been working with the Turkish government for the past year making mining and oil reconnaissances.

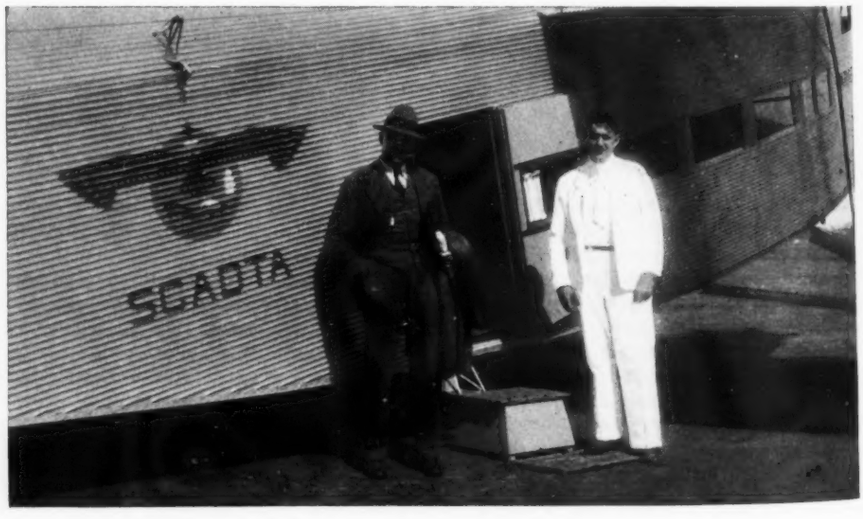
SIR HARRY DUNCAN MCGOWAN, chairman of Imperial Chemical Industries Ltd., is one of the three barons created by King George VI on his first list of birthday honors. Born in Glasgow in 1874, Sir Harry went to work when 15 years old with Nobel's Explosive Company for a wage of $1.25 per week—in 1934 he was reported to be the highest salaried industrialist in Great Britain. He was knighted in 1918 for his work in amalgamating the principal munitions concerns and in 1926 he carried this step forward by establishing Imperial Chemical Industries, in conjunction with Lord Melchett. As chairman of this enterprise, which owns and operates England's huge coal-hydrogenation plant for synthetic manufacture of gasoline, Sir Harry directs a government-subsidized experiment for producing gasoline from indigenous sources which is being watched with keen interest by the international oil industry.

THOMAS E. WARD, who has been president of the Society of Mexico Pilgrims from 1929 to 1937, has been elected a life member of that Society. The certificate of life membership was presented to Mr. Ward at an informal luncheon of the executive committee, held in his honor, on February 19 at the Machinery Club in New York. Among members of the organization are a number of men well-known in the oil industry, including Capt. James W. Flanagan, president of the Andean National Corp., who is also a life member.

FRIENDS throughout the oil industry will be grieved to learn of the sudden death of Bill Gray at his home in Elizabeth, New Jersey, on March 5, 1937. He was 43 years old. Over a period of years Mr. Gray had been associated with the Bigheart Oil & Refining Co., Barnsdall Refining Corp., Standard Oil Co. of New Jersey, and the National Andean Corp. While with the latter organization he spent some time in Colombia. At the time of his death he was associated with the E. B. Badger & Sons Co., of Boston and New York. Bill Gray was born in Elizabeth, New Jersey, and attended Pingry School, from there going to Morristown School, Morristown, New Jersey. After finishing at Morristown he entered the Massachusetts Institute of Technology, class of 1917. He left college and went overseas with the 5th Division, 6th Infantry as 1st Lieutenant, returning to M. I. T. after the armistice and finishing his course in 1919. It was natural for Mr. Gray to be affiliated with the oil industry as he was the grandson of the late P. R. Gray, one of the first petroleum refiners in the United States; nephew of Alanson McDowell Gray, John L. Gray and the late T. T. Gray, inventor of the Gray vapor-phase cracking process. He is survived by his widow, Katharine Partridge Gray, a daughter, Edith Stevens Gray, and a son, William Ayres Gray III.

B. E. JOHNSTON, formerly with the Lago Petroleum Company, was appointed foreign sales representative for I. Frank Brown last December 1st, and will travel throughout

Rex Townsend, manager, and Mr. Christian, camp boss of Socony-Vacuum operations in Magdelena Valley, Colombia.



Venezuela, Colombia and Trinidad on behalf of the specialty companies Mr. Brown represents. Mr. Johnston has been in the Maracaibo Basin fields of Venezuela for nine years. S. D. Beckley, who has been with the Hughes Tool Company in Oklahoma and Kansas for the last year and a half, joined I. Frank Brown's staff on January 16th. Mr. Beckley visited the shops of the Guiberson Corp. in Dallas, the Texas Rubber & Specialty Corp. in Houston and others, and continued on out to the Globe Oil Tools Co. and Baash Ross Tool Co. in California, before reporting to the New York office on March 1st. Mr. Beckley was accompanied on this tour by his attractive bride, the former Miss Lucy May Smith, whom he married on January 24th at Shawnee, Oklahoma. These staff-additions are in line with the gradually expanding operations of I. Frank Brown which started in New York June 15, 1936. Mr. Brown is export representative of Globe Oil Tools Co., Guiberson Corp., Fred I. Getty, Texas Rubber & Specialty Corp., and The Shaffer Specialty Co.

John Skliros.

F. C. RIPLEY, JR., South American representative for Continental-Emsco Company, returned on February 27 to his Port of Spain, Trinidad, headquarters after having completed an interesting and successful trip through Colombia, Ecuador, Peru and Venezuela. During his seven-week journey he traveled by plane, railroad, steamship, automobile, mule-back, and screened-launch (a boat screened-in to provide protection against the deadly arrows of the Motilone Indians). Mr. Ripley expects to leave Port of Spain again about April 1 by plane and cover all Argentine, Bolivian, Peruvian and Ecuadorian fields, after which he will return to his home in Los Angeles, California, for a three-month vacation.

F. C. Ripley, Jr. in Plaza Ibogue, Colombia, with Andes in background.

JOHN SKLIROS, London manager of the Iraq Petroleum Company, was a recent visitor to Baghdad. He inspected the Kirkuk oilfields as well as those in the Mosul region. International oil men consider Mr. Skliros' presence in Baghdad particularly significant at this time, as it is believed that he is making arrangements connected with increased activity in British Oil Development Company operations west of the Tigris River in Iraq.

CAMPBELL M. HUNTER, O.B.E., arrived in New York from London on the EUROPA February 26th. Mr. Hunter, Chairman of Board of the Hunter Valley Oil Company, Ltd., is on his way to Alberta, Canada, to inspect drilling operations of his company.

SERGO ORDJONIKIDZE, Soviet Commissar for Heavy Industries and second in power only to Joseph Stalin, died in Moscow February 18 of a heart attack. He was 50 years old and his untimely death may be termed a terrible blow to the Russian oil industry. Stalin's bosom friend and fellow-Georgian, Ordjonikidze was one of a fine, high-minded type of man who is rapidly growing scarce in Russian administrative circles. He led a frugal life, worked hard, and had a zealous devotion to the government and the Communist cause in Russia. Throughout his career he was the driving power behind the industrialization of the Soviet Union. He did not hesitate to excoriate the Russian oil industry for its shiftless, inefficient practices; nor was he afraid to face the bitter realities of conditions. Besides holding the Soviet's most important non-political post, Ordjonikidze was a member of the Politbureau, an all-important group of 10 men within the Communist party who rule Russia, and was chairman of the Supreme Council of National Economy. He was considered Stalin's political heir, or at least the prospective head of a group that would control the Soviets in the event of Stalin's death.

Sergo Ordjonikidze.

BRITISH DISTRIBUTORS

Enjoy Increased Demand, Higher Prices

ALEC H. DAY

DISTRIBUTORS of petroleum products in Britain are now in a better position than they have been for many years. Selling prices are on a more profitable basis, and consumption is increasing.

Two rises of ½d. per gallon in motor spirit since the beginning of 1937 have raised the price to its highest since 1933, when the quotation for first grade spirit was 1s. 7½d. With the recent establishment of a standard price of 1s. 7d., first grade spirit now shows an increase of 2d. on the figure ruling as recently as 1935, when world trade depression and overproduction of petroleum were having their greatest effect on British prices.

Distributors naturally receive the full 1s. 7d., less retailer's margin, on only a part of their total turnover. Commercial spirit, and sales under contract, account for a very large proportion of the total trade, but the rise in No. 1 spirit has been followed by quotations for cheaper grades, and thus reflects a general advance in the price level.

There is no need to look further than the cost of replacement to account for the higher price range now effective. The first advance of ½d. per gallon, which came into force on January 13, reflected improvement in the United States oil position. Before the market had time to react to this initial increase in selling prices, the further strengthening of the American position and a sharp rise in tanker freights called for another advance of ½d. in British prices.

Other factors contributing to the advance have been the activity of the British demand for petroleum products and the absence of undercutting by independent motor spirit distributors.

Consumption in Britain has been increasing steadily as internal trade has improved. Customs releases for the whole of 1936 were 36,097,000 bbl., an increase of 3.9 percent on the aggregate for 1935 and of 5.2 percent on that for 1934, and the £400,000,000 rearmament plans of the British Government hold out the prospect that sales of petroleum will continue at a high level for a considerable time.

Beyond an enlarged use of lubricating and fuel oil, the Government's steps to strengthen Britain's defences have made little difference as yet to the country's demand for oil. Larger sales of motor spirit and other products have merely reflected normal trade recovery, which has had little stimulus from defence work up to the present time. Most of the benefits from rearmament expenditure have still to be felt in general trade, and therefore in the consumption of petroleum products. Prospects in the motor spirit market are therefore sufficiently promising to have given distributors considerable confidence in their price policy.

A further impetus towards higher motor spirit prices has been the inactivity of the smaller independent distributors. Formation in 1935 of the Independent Petroleum Federation has strengthened the position in this respect by bringing all the more responsible of the small independent firms under a single authority. Competition on uneconomic lines between this type of distributor has thus been greatly reduced. At the same time, improvement in the international oil situation has largely eliminated the arrival in British ports of distress oil cargoes, thereby cutting off the supplies of motor spirit which could come into the hands of completely uncontrolled and irresponsible distributors. This was the class of operator which formerly caused most annoyance and disturbance to the established distributors in the British market.

With demand active, and uneconomic competition greatly reduced, the market has as a matter of course been more responsive to improved United States prices and the rise in freight charges. Increased costs of distribution have also contributed towards higher prices for motor spirit. That wages in Britain were tending upward was a factor which has had to be taken into consideration in fixing new price levels.

Quarters outside the oil industry, including the London Stock Exchange, are already beginning to discuss possibilities of a further advance in motor spirit prices when the summer motoring demand gathers force. Such talk is regarded as irresponsible in oil circles, where it is believed that the future price level will not depend upon consumption, but upon the cost of spirit as determined by Gulf prices and the tanker freight market.

That an advance in the quotation has already taken place is all to the good, for the British Budget is in course of formation, and the Chancellor of the Exchequer is reputed to be searching for new sources of taxation as a help towards his heavy expenditure on national defence. An increase in the petrol tax, which already absorbs 8d. per gallon of the total price of 1s. 7d. paid by the British motorist for first grade spirit, seems almost unthinkable. If it were imposed now it would raise the selling price to a decidedly high level, but the outcry in such circumstances would be against the excessive level of the tax, whereas if the tax were increased and the price of spirit raised afterwards, importing and distributing companies might come in for a good deal of public censure. Circumstances, therefore, seem to have forced a rise in motor spirit prices at a fortunate time for the oil companies, any Treasury designs for increasing taxation having been forestalled.

As it stands at present, the price of motor spirit in Britain has been placed upon a reasonable basis. It is sufficiently high to provide the integrated companies, possessing their own sources of crude, with a fair but by no means extravagant profit. It may also be just remunerative to distributors who have to purchase their supplies overseas and pay for transportation, but is still by no means promising for new entrants into importing and distributing business.

Since selling prices for kerosene, gas oil and fuel oil have all risen since the beginning of the year, British petroleum trade as a whole may be considered on a sound basis at the higher price levels established on both sides of the Atlantic.

There is certainly a spirit of optimism among oil men in Britain which has been absent for several years. Nevertheless, the fair measure of prosperity which seems in view is expected from a larger turnover rather than from expanding profit margins. This attitude certainly seems justified by the prospect of continued internal trade activity in Britain, and its effect on the demand for petroleum products.

BRITISH IMPORTS DECLINE

British imports of petroleum began the current year with a decline compared with 1936. The total of refined products received during January, at 4,877,000 bbl., showed a reduction of 10 percent on the corresponding month of last year, and although a moderate rise took place in inward shipments of crude, the total of all oil imports for the month was 4.8 percent less than in 1936. Motor spirit imports were greatly reduced, shipments from all the principal exporting countries being lower, but fuel oil receipts advanced substantially, owing to larger imports from the British West Indies, Iran and Mexico. The month's import statistics do not present a true picture of the British market, where consumption is evidently still tending to increase, and the reduction in the volume must be attributed entirely to the incidence of tanker arrivals. A better idea of the trend of British oil business will only be possible when statistics are available for a longer period of the year.

BRITISH OIL IMPORTS BY PRODUCTS

(Barrels)

	January 1937	January 1936
Kerosene	561,000	637,000
Motor spirit	2,102,000	3,109,000
Lubricating oil	156,000	242,000
Gas oil	288,000	259,000
Fuel oil	1,727,000	1,140,000
Other sorts	43,000	31,000
Total products	4,877,000	5,418,000
Crude	1,459,000	1,240,000
Total imports	6,336,000	6,658,000

WORLD OIL PRODUCTION—Official Figures

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified

(Figures in U.S. Barrels—Conversion ratio 7 bbl. = 1 ton)

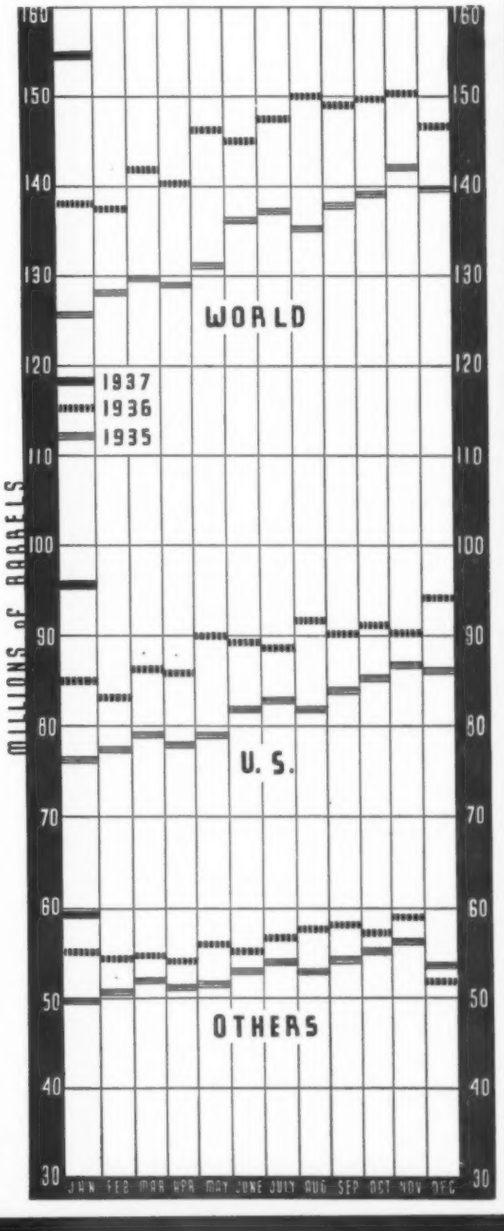
Country	February 1936	March 1936	April 1936	May 1936	June 1936	July 1936	August 1936	September 1936	October 1936	November 1936	December 1936	Provisional Figures January 1937
United States	82,120,000	90,568,000	90,479,000	93,739,000	90,185,000	92,078,000	95,090,000	90,972,000	95,795,000	91,018,000	97,652,000	98,567,000
Russia	15,288,700	16,344,300	15,589,000	16,454,200	15,955,100	16,231,600	15,737,500	14,936,600	16,118,900	16,700,000 [1]	16,400,000 [1]	16,100,000
Venezuela	12,849,480	13,432,671	13,442,870	13,732,933	12,486,600	14,566,510	14,632,737	14,626,073	13,888,287	14,307,650	8,452,626	13,543,900
Roumania	4,809,000	5,209,000	5,226,000	5,568,000	5,563,000	5,606,000	5,585,000	5,254,000	5,224,000	4,982,000	5,050,000	4,768,000
Iran [2]	4,480,000	4,641,000	4,312,000	5,376,000	5,061,000	4,872,000	5,117,000	4,487,000	4,704,000	4,620,000	4,963,441 [1]	4,849,919
Netherland India	3,407,194	3,670,877	3,532,375	3,721,613	3,549,417	3,725,491	3,715,887	3,731,973	4,059,426	4,139,954	4,190,578	4,009,355
Mexico	3,285,965	3,542,088	2,997,883	3,235,255	3,167,300	3,179,614	3,773,503	3,768,855	3,235,224	3,204,007	4,259,733	6,120,635
Iraq	2,107,210	2,515,345	2,048,053	2,467,136	2,473,660	2,440,669	2,479,428	1,881,782	2,097,564	2,214,954	2,207,954	2,476,698
Colombia [3]	1,475,403	1,619,620	1,427,193	1,598,544	1,529,901	1,585,345	1,553,606	1,575,273	1,600,288	1,537,683	1,641,636	1,668,490
Peru [4]	1,293,627	1,351,810	1,403,626	1,500,485	1,452,306	1,524,303	1,527,072	1,478,482	1,507,433	1,445,605	1,492,023	1,448,545
Argentina	1,273,243	1,366,691	1,260,277	1,231,354	1,140,080	1,286,536	1,293,283	1,323,730	1,306,784	1,310,000 [1]	1,472,748 [1]	1,317,252
Trinidad	983,424	1,081,191	1,026,423	1,066,728	1,078,186	1,121,583	1,108,969	1,126,420	1,179,611	1,154,093	1,231,365	1,263,456
British India	756,384	791,162	790,376	827,762	778,947	817,364	815,415	791,217	660,000 [1]	658,000 [1]	765,576 [1]	788,299
Poland	323,400	338,800	323,400	331,100	287,000	294,000	301,000	294,000	301,000	294,000	301,000	308,000
Brunei	237,930	257,250	270,900	225,890	206,780	266,700	275,310	257,040	294,070	294,560	322,210	354,480
Germany	227,444	274,393	246,519	244,552	256,613	272,699	257,859	255,556	277,158	265,650	279,545	265,531
Japan	165,877	196,369	194,167	203,071	198,387	206,284	221,139	207,260	200,528	202,385	212,326	214,524
Ecuador	138,721	162,125	159,666	163,855	156,703	163,714	160,914	158,857	168,892	163,870	175,918	180,058
Sarawak	127,050	136,290	130,900	134,610	128,660	130,200	129,150	122,010	127,330	122,920	128,240	125,440
Canada [5]	107,928	117,824	107,748	114,297	114,050	139,940	139,789	135,623	137,004	129,152	139,701	127,689
Egypt	97,573	111,846	101,038	107,989	106,694	106,260	102,620	98,812	102,109	97,755	98,672	99,589
France [1]	42,079	44,981	43,530	44,981	43,530	44,981	45,000	45,000	45,000	45,000	45,000	45,000
Bahrein [1]	300,000	300,000	300,000	360,000	360,000	360,000	360,000	372,000	372,000	372,000	372,000	1,100,000
Others [1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	135,972,632	148,148,833	145,487,944	152,514,355	146,353,914	151,094,793	154,497,181	147,974,563	153,476,608	149,354,238	151,929,292	159,816,860

[1] Estimate. [2] Anglo-Iranian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] International Petroleum Company's figures. [4] International Petroleum Company and Lobitos Oilfields Ltd. figures. [5] Includes natural gasoline production.

Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan.

Official Crude Oil Production Figures for 1932 to 1937

	Daily Average to Jan. 31 1937	Daily Average 1936	Total to Jan. 31 1937	Total 1936	Total 1935	Total 1934	Total 1933	Total 1932
United States	3,173,390	3,001,410	98,567,000	1,098,516,000	996,596,000	908,065,000	905,656,000	785,159,000
Russia	519,355	524,348	16,100,000	191,911,200	176,688,100	168,648,700	149,901,900	149,719,000
Venezuela	436,900	436,900	13,543,900	159,905,526	154,021,599	140,784,805	120,882,802	119,596,512
Roumania	153,806	173,527	4,768,000	63,511,000	61,150,000	62,006,000	50,971,200	50,491,205
Iran	156,449	156,449	4,849,919	57,260,441	52,413,879	52,663,782	48,581,280	45,122,455
Netherland India	129,334	122,030	4,009,355	44,662,857	42,569,625	42,289,408	38,512,663	39,584,027
Mexico	197,440	112,095	6,120,635	41,026,724	40,234,902	38,167,022	33,904,882	32,802,285
Iraq	79,893	74,484	2,476,698	27,261,087	24,850,924	7,935,657	1,200,000	1,200,000
Colombia	53,822	51,246	1,668,490	18,756,110	17,617,654	17,340,724	13,157,127	16,834,956
Peru	46,727	47,415	1,448,545	17,353,778	16,835,206	15,936,937	13,923,281	9,899,266
Argentina	42,492	42,492	1,317,252	15,551,998	14,317,500	14,045,652	13,759,565	13,166,900
Trinidad	40,757	36,167	1,263,456	13,237,075	11,669,792	10,894,363	9,560,039	10,023,780
British India	25,429	25,429	788,299	9,306,847	9,227,496	8,997,399	8,721,655	8,600,312
Poland	9,935	9,773	308,000	3,577,000	3,612,000	3,697,617	3,858,085	3,905,230
Brunei	11,435	8,639	354,480	3,162,040	3,162,614	2,673,041		
Germany	8,566	8,504	265,531	3,112,480	3,054,023	2,266,964	1,712,823	1,824,019
Japan	6,920	6,515	214,524	2,384,378	1,848,656	1,484,962	1,337,761	1,575,333
Ecuador	5,808	5,252	180,058	1,922,215	1,725,354	1,655,062	1,622,624	1,573,857
Sarawak	4,046	4,253	125,440	1,556,660	1,811,297	1,948,044	2,289,472	2,274,043
Canada	4,119	4,110	127,689	1,504,287	1,447,204	1,422,869	1,162,541	1,044,412
Egypt	3,213	3,341	99,589	1,222,865	1,215,606	1,479,037	1,591,495	1,742,370
France	1,452	1,459	45,000	534,063	529,664	552,000	552,000	552,000
Bahrein	35,484	11,279	1,100,000	4,128,000	1,264,809	285,071		
Others	2,419	2,459	75,000	900,000	900,000	861,000	432,000	432,000
	5,149,191	4,869,576	159,816,860	1,782,264,631	1,638,763,904	1,506,101,116	1,424,331,195	1,296,672,962



World crude oil production by months, 1935–1937. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry. **Edited by Dr. O. W. Willcox**

Petroleum Geology

METHOD OF IMPREGNATING POROUS MATERIALS TO FACILITATE PORE STUDIES.—Allen W. Waldo and S. T. Yuster, in BULL. AMER. ASSOC. PETROL. GEOLOGISTS, vol. 21 (1937), No. 2, pp. 259–267.

An efficient method for the impregnation of porous materials, particularly of low permeabilities, for the purpose of studying the pore system is described. A brief review of previous methods is given, as well as a description of the proposed method and apparatus.

In brief, the method consists of evacuating the air from a clean, dry specimen at room temperature, immersing it in molten balsam, to which an oil-soluble dye has been added, and then forcing that balsam into the evacuated pores under pressure.

The equipment is very simple and inexpensive. It requires only an air-tight cylinder, a means of evacuating it, a method of later applying pressure within it, and a heating unit which will melt the balsam at the proper time.

The pores, as they appear in the resulting sections, are impregnated with the brilliantly dyed balsam, so that a complete study of their size, shape, number, interconnections, and distribution is possible.

INTERRELATIONSHIP OF GEOLOGY AND GEOPHYSICS.—O. L. Brace, in BULL. AMER. ASSOC. PETROL. GEOLOGISTS, vol. 21 (1937), No. 2, pp. 197–211.

Geophysics has advanced to such an important place in the field of structural prospecting that there is a tendency, in some quarters, to relegate the geologist to a position of secondary importance in this field. Geophysics is here regarded as purely a new and complex means of reading strike and dip and, as such, is to be classed as an additional geologic tool.

Geology serves as an indispensable guide to every step of geophysical activity, and without such guidance, the geophysicist can not hope to reach his objective. Lack of coördination between the two technical branches has led, in the past, to much misinterpretation of geophysics and continued future success will depend upon a greater degree of coöperation in preparing the background for geophysical prospecting and in interpreting the results obtained by such methods.

In order that both geologist and geophysicist may benefit most effectively, the following suggestions are summarized.

1. *That the general direction of any oil-prospecting campaign be placed in charge of a competent geologist.* The obvious advantage of this arrangement is that, in laying out the areas to be prospected, full advantage may be taken of all the accumulated geologic knowledge, both in its bearing on the character of the records to be anticipated and on structural interpretation.

2. *That each geophysical field party should be accompanied by a competent field geologist.* This individual may guide the work from day to day and thus take full advantage of available geologic information. One of his important duties should consist of seeing that sufficient work is done where needed to avoid resurveying and in preventing needless work in areas that have no bearing on the particular problem.

3. *That an office geologist be detailed to work side-by-side with the geophysicist who makes interpretative maps.* The combination of training and experience in both geophysically applied physics and applied geology will produce results that will be devoid of many of the obvious errors that have characterized much of the unguided geophysics of the past.

ORIGIN AND DISTRIBUTION OF BARTLESVILLE AND BURBANK SHOESTRING OIL SANDS IN PARTS OF OKLAHOMA AND TEXAS.—N. Wood Bass et. al., in BULL. AMER. ASSOC. PETROL. GEOLOGISTS, vol. 21 (1937) No. 1, pp. 30–66; 17 figs.

This paper, based on a two-years' investigation, draws a striking parallel between the physiography of the ancient Cherokee Sea and certain parts of the present Atlantic Coast.

The Burbank sand bodies particularly occur in definite systems, called "trends," made up of lenses that are separated by gaps containing no sand. The individual sand lenses have an offset arrangement within the trends. Similar features are found in the systems of offshore bars on the Atlantic and Gulf coasts. The shapes in cross section of the shoestring oil-bearing sand bodies are similar to those of offshore bars. The composition and physical characteristics of the oil-bearing Bartlesville and Burbank sands are similar to those of the sands that form the modern offshore bars on the Atlantic and Gulf coasts. Many modern offshore bars, of which that at Cape Henry, on the Virginia coast, is an example, are made up of a series of overlapping beaches that have been preserved as ridges of sand trending parallel with the coast. These ridges represent lines of beach growth. The sand body of the main Burbank oil field, that of the Stanley stringer on its eastern margin, and the sand body of the South Burbank oil field appear to be characterized by features that may be growth ridges.

The studies indicate that the Bartlesville sand was deposited as a series of offshore bars along the western shore of the Cherokee sea during an early stage of the sea when the western shore migrated to and fro across a narrow strip of country in northeastern Oklahoma and southeastern Kansas. The Burbank sand bodies were deposited much later, after the Cherokee sea had expanded widely to the northwest. The trends of Burbank sand were deposited as offshore bars mainly during the Teeter-Quincy and Sallyards-Lamont stages of the Cherokee sea. The sand bodies of the Burbank and South Burbank oil fields are tentatively assigned to the Teeter-Quincy stage and are believed to have been formed by a series of overlapping beach deposits similar to those that form Cape Henry, Virginia.

On the basis of these studies the authors feel warranted in presenting a sketch map of the shore line of this ancient sea indicating the present and possible oil bearing sands of the region; this map should be consulted by those interested.

It is recommended that, in prospecting for additional shoestring-sand oil fields, drilling sites be selected by projecting the known shoestring-sand trends in approximately straight lines similar to the trends of the systems of offshore bars on our present coasts, and not by meandering lines similar to stream courses. Inasmuch as modern offshore bars and the developed shoestring-sand bodies have an offset or *en échelon* arrangement within the systems and have gaps separating the individual sand bodies, these features should be expected in the projection of the sand trends into undeveloped territory.

Drilling

CHEMICAL AND PHYSICAL CONSIDERATIONS IN THE CEMENTING OF OIL WELLS.—A. Reid, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 158, pp. 798–802.

There is a general but mistaken notion that any construction cement is good enough for oil-well cementation, and this idea is responsible for many failures. In the first place cements differ notably in their characteristics, especially as to setting and hardening rates; they are classed as:

(1) Slow setting and slow hardening.
(2) Slow setting and rapid hardening.
(3) Rapid setting and slow hardening.
(4) Rapid setting and rapid hardening.

The question arises, which of these types is

best suited for oil well cementing? Much depends on the actual conditions. Ultra rapid-setting cement is out of the question; a very slow-setting cement is sensitive to underground conditions. After many tests it was found that for 4,000 to 5,000-ft. jobs in Burma a mixture of 40 parts by weight of water to 100 parts by weight of cement showing a set in 2 to 2½ hours at 100 deg. F. would be satisfactory. Cements setting in 3½ hours have been successfully used, but do not give such good results when active water sands have to be shut off.

After setting, the sooner a cement acquires strength and becomes impermeable, the better. Hence rapid hardening cements are to be preferred, especially for that part of the column placed in the neighborhood of the casing shoe. A tentative specification for oil-well cement offered at the World Petroleum Congress calls for tensile strengths of 250, 350 and 425 lbs. sq. in. in one, three and seven days respectively; the one day figure is the most important; cements which pass the three- and seven-day tests but not the one-day test are likely to fail.

Given sufficient time, old cement will attain practically the same strength as freshly manufactured cement, but if the 1-day strength is accepted as important in oil-well work, the effect of ageing is likely to spoil the chances of a successful cementation. Hence cement intended for oil-well work should be stored in airtight drums.

The setting and hardening properties of cement can be modified by additions of calcium chloride or gypsum, so that these properties can be gauged to suit conditions. It appears to be best for the oil well cementer to keep two types of cement, one slow-setting for deep wells and one slightly more rapidly setting for wells of 4,000 to 5,000 ft., or to use only slow setting cement and make careful additions of calcium chloride as required.

Aside from the quality of the cement itself, underground influences have to be taken into consideration. The higher the temperature the more rapid the setting, so this matter should be studied when fixing the grout to be used; a rule followed by the author is to carefully observe the temperature of the circulating mud and add 10 to 12 deg. F., and the grout is tested at that temperature. In deep wells (more than 3,000 ft.) pressure reduces the time of setting. Motion of the slurry lengthens the setting time, but by how much is still uncertain. Dilution with the well water lengthens the setting time and reduces final strength. The effect of salts on setting and hardening rates is not thoroughly understood, but experience in Burma indicates that the effect of well waters on cement is not very serious except where the slurry is excessively diluted or agitated. Agitation of the slurry with oil or gas may have deleterious effects. A small quantity of rotary mud will not affect the strength of the cement, but an appreciable quantity may be extremely prejudicial, especially if it contains soluble salts. Finally, cement will bond better with certain formations than with others.

ACCURACY OF WELL SURVEYING.—I. P. Sanders, in OIL AND GAS JOUR., vol. 35 (1937), No. 39, pp. 57–58.

In the drilling of a well in the Fitts field, it occurred that the new well drilled through the casing of a producing well which, at the surface, was 75 ft. distant. The producing well was thereby accidentally killed and although the incident represented a misfortune, it provided the best opportunity to date for checking the accuracy of directional well surveying. Oriented surveys were made of both wells, and the figures of this survey indicated that the new well had drifted into the producer at a depth of 4,018 ft. As a check on this survey a plug was pumped down the producing well, and by running a measuring line it was found that the plug had stopped at 4,018 feet, which proved the accuracy of the oriented surveys.

Although the two wells drifted together, it is interesting to note that they did not drift in a straight course between the two wells. No. 1-A took a spiral course, starting down structure, then swinging to the east and around to the north so that it was going up structure. The tendency of drifting is usually up structure on formations of a low-dipping angle. No. 1, however, turned to the west as the drift angle increased, and drifted parallel to the structure to the point of coincidence.

ESSENTIALS OF SUCCESSFUL CEMENTING JOBS.—B. Mills, in OIL WEEKLY, vol. 84 (1937), No. 4, pp. 19–24.

The failures of cementing jobs arise from various definite causes which can be more or less completely obviated by bearing in mind accumulated experience, especially if there is close cooperation between the oil operator and the cementing company. Among important factors is the nature of the formation between the bottom of the hole and the highest point to which the cement is expected to rise. Cement will not bond satisfactorily to true clays and shales, and many unsatisfactory shutoffs should be charged to this deficiency. It is not a fault of the cement that it will not bond to certain clays and shales. Since a strong packing action is needed to offset a definite bond, it may be necessary to use more than the calculated amount of cement to effect a satisfactory shutoff. Where the cement has bonded well to the casing and has tightly filled all space between the hole and the casing, the treachery usually accompanying a clay or shale wall may be overcome.

Contamination of cement is a serious problem. Cement used should possess a quality that prevents, or at least checks, ordinary contamination with drilling mud. A gel type cement is recommended by many operators for resisting contamination. The need for a mechanical means to prevent contamination is pressing.

Sulphate waters eventually disintegrate cement, the magnesium sulphates being the most destructive. This is the one natural force that will affect cement in its usual line of service. The length of service rendered by cement in a sulphate water area depends on the strength of the water. The presence of such water does not always prevent securing a temporary water shutoff.

A very important point is that the pipe in the hole should be centered as accurately as possible during cementing operations. Where the pipe lies close to or against the wall of the hole the result will be unsatisfactory, and water infiltration with the oil through gun perforations at such places will give trouble. If necessary reaming should be resorted to for assuring a full ring of cement around the casing.

Use of the exactly calculated amount of cement required to fill the hole does not always lead to success, because there is no guarantee that such calculations can ever be exact; caverns and irregularities of unknown extent may exist. A safe rule, and one that has been pursued with success by a large producing company on the Gulf Coast, is to use double the quantity of cement indicated by calculation, and since this rule was adopted every cementing job has been a success. One virtue of using plenty of cement is that the excess acts as an effective scavenging agent in removing mud left on the wall that would contaminate the outer fringe of cement and thus result in an unsatisfactory bond. It is too much to expect a small quantity of cement to perform this cleansing operation.

The presence of air in the column during cementing operations often causes trouble; this may be obviated by use of a special plug head that will prevent entry of air between the last cement run and the mud that follows.

Some operators use a heavier cement for the last 20 percent of the mix so as to avoid too much thinning by the water inside the casing. Most of the other sources of difficulty are known to the cementing companies, and more or less satisfactory methods are available for overcoming them. Still, not the least important among the factors of success is the use of plenty of cement.

Oil Well Operation

TEMPERATURE MEASUREMENTS IN OIL WELLS.—By M. Schlumberger, H. G. Doll and A. A. Perebinossoff, before Institution of Petroleum Technologists, November, 1936 (London).

Continuous temperature measurements in oil wells can now be made with a new and extremely sensitive recording thermometer. They can be applied to a great number of oil-field problems, both in wells in thermal equilibrium and in wells in thermal evolution, and also both in open and in cased holes.

The data on geothermal gradients and their variations interest both the regional and local geologist. Knowledge of subsurface temperatures can aid the technologist in problems related to mud and cementing.

Temperature measurements can yield valuable corroborative data on the sequence of formations in a well, the main data always preferably being given by electrical logging. They can be applied to location of water, oil- or gas-sands, both in drilling and in already tested or produced wells. They are invaluable for checking the results of a cementing operation.

The paper presents the principles of the major thermometric techniques, and illustrates them with some practical examples. In conclusion, attention is drawn to the time and care that may sometimes be required for optimum results, but practice has already proven that the best local operating conditions are very soon determined in most regions, thanks to the spirit of cooperation existing between the surveyor and the local technologists.

LABORATORY STUDY OF REPRESSURING PROJECTS.—Frank B. Taylor in OIL WEEKLY, vol. 84 (1936), No. 2, pp. 48–54.

Successful operation of any type of secondary recovery project is dependent upon accurate and exhaustive laboratory tests. The author describes the equipment and operation of a laboratory used in connection with a repressuring project involving three blocks comprising 2,400 acres in southeastern Kansas,

each block containing a different producing sand. All tracts under examination are drilled with cable tools to the producing horizon and are then cored with 2-inch rotary equipment. As cores are taken, samples are broken from each foot of recovery. These representative sections are then wrapped immediately in cellophane and sealed in fruit jars for transportation to the laboratory, where the volume of oil contained in the sand, pore space and permeability are determined by approved methods. The data thus obtained, when correlated with field data, give a basis for establishing specification factors for the field equipment necessary for repressuring.

PERFORMANCE, ETC. OF DIRECT GAS-ACTUATED PLUNGER UNITS.—G. A. Walling, in JOUR. INST. PETROL. TECHNOLOGISTS, vol. 22 (1936), No. 157, pp. 727–739.

Briefly, an installation consists of a string of tubing manufactured to closer limits than standard (the tolerance allowed being ± 0.01 in.). This flow string may be considered the working barrel of the pump. A steel plunger travels back and forth from top to bottom of the flow string. In its downward travel the plunger passes with its valve open through fluid in the lower part of the tubing, until reaching the foot-piece, where the valve is automatically closed on to its seat. Gas pressure from the casing then elevates the plunger to the top of the flow string with a slug of oil above it and discharges the fluid through a choke. At the top of its stroke the plunger, together with a small portion of lifted fluid, runs into a chamber, where the valve is pushed off its seat by the dead fluid above it allowing the gas below to exhaust through the plunger as the latter returns to the foot-piece at the lower end of the flow string.

By means of the choke on the discharge of the flow string the rate of production of the well may be controlled in similar fashion to any normal flowing well. Also it serves to check the release of the lifting gas as the plunger is falling to bottom. Too high a gas velocity through the flow string during this period will blow the valve of the plunger up on to its seat, resulting in the plunger returning to the surface before having reached the foot-piece at the lower end of the flow string.

The gas energy for operating the plunger may be either supplied solely by the gas entering the well with the crude from the formation or, if this is insufficient, additional gas may be admitted to the casing from some surface supply. It will be appreciated from the above outline of operation that there is a pressure in the annular space between the casing and tubing throughout the operation.

The volume of gas required for lifting purposes is directly proportional to the length of the flow string or working barrel for any given rate of production.

Lifting costs are very low where sufficient formational gas is available to make the units self-sustaining. Under these conditions the costs are comparable with those of flowing wells.

INFLUENCE OF PRODUCTION PRACTICE ON GRAVITY OF THE OIL.—R. R. Boyd, in OIL WORLD, vol. 30 (1937), No. 1, pp. 8–11.

It is a frequent occurrence for operators to be called on by royalty owners for explanation of variations in the gravity of oil shipments. Such changes in gravity involve two separate phases: gravity changes of the fluid within the reservoir, and changes brought about in the wells, lines and traps according to the methods of operating. Changes to lower gravity within the reservoir may be due to migration, as in an old field under water drive, but the opposite change to higher gravity may be due to downward movement of lighter oil originally accumulated at the top of the structure. Liberation of gas in the reservoir naturally has a bearing on the gravity of oil entering the well.

Among gravity changes brought about by producing operations, there may arise five cases. (1) Release of pressure on the well head; the effect is eventually a lowering of the gravity. (2) Change from flowing to gas lift operations. The effect may be an immediate drop in gravity, which rises again under pumping operations. (3) Substituting wet gas circulating for dry gas in gas lift operations. Under dry gas circulation the gravity may vary considerably; a change to wet gas may bring about an immediate increase. (4) Producing wells with periodic intervals of idleness. After each shut-in period the gravity tends to be high, followed by low gravity after the well has been on production for several weeks; on continuous production the gravity is continuously low. Some pumping wells show a close approximation to a straight line decline in gravity. (5) Vacuum on the casing head. During the period of high fluid levels the ratio of gasoline to oil drops and the gravity increases. If the primary separation of gas is made at high pressure it may be expected that the gravity of the oil will be conserved by high pressure traps.

Summarizing, the gravity of the oil may be conserved by carefully regulated pressure control at the well head, by primary separation of the gas at high pressure, use of wet gas in gas lift work, maintenance of high fluid levels, and smooth pumping motion. Abrupt drops in pressure are to be ascribed, among other reasons, to marked drops in well head or trap pressures, circulation of dry gas for gas lift work, low fluid levels and poor pump operations.

Petroleum Refining

THERMAL STABILITY OF PARAFFINIC AND OLEFINIC HYDROCARBONS.—Gustav Egloff and C. I. Parrish, in CHEMICAL REVIEWS, vol. 19 (1936), No. 2, pp. 145–161.

The relative stability of hydrocarbons determines the course of the pyrolytic (cracking) reactions. If these stabilities were all known it would be easy to arrange things so as to obtain desired hydrocarbons, but unfortunately this knowledge is not completely available. However, it is possible to estimate relative stabilities by a comparison of results obtained on paraffins and olefines under comparable conditions. The authors have combed the literature of the subject and have arrived at the following conclusions:

The relative stability of the paraffins toward decomposition decreases in the following order: methane, ethane, propane, iso-butane, butane, neo-pentane, *n*-pentane, iso-pentane, *n*-hexane, and 2-methylpentane.

At 600 deg. C. the stability of the olefins toward the formation of higher hydrocarbons decreases in this order: ethylene, propene, 2-butene, and 1-butene; at higher temperatures the specific behavior is lost and they are of the same order of stability. At 371 deg. to 457 deg. C. under high pressure, ethylene is less stable than propene. These differences are probably due to different experimental methods or conditions.

Toward decomposition the following order of decreasing stability is estimated at 600 deg. to 700 deg. C.: ethylene, propene, iso-butene, 2-butene, 1-butene, trimethylethylene, 2-pentene, and 1-pentene; iso-butene was found to be less stable than 1-butene at 1,100 deg. C. and 50 mm. pressure.

Toward isomerization 1- and 2-pentene are less stable than 1- and 2-butene, which are about the same. The pentene stability decreases in the order: trimethylethylene, isopropylethylene, 2-pentene, and 1-pentene.

The diolefins are more susceptible to polymerization than the mono-olefins. The dimethylbutadienes become more stable as the methyl groups are moved from the center of the molecule.

Specific conclusions as to the relative thermal stabilities of paraffins and olefins are not wholly warranted as yet, because strictly comparable data are unavailable.

MANUFACTURE OF SYNTHETIC FUELS AT BETHUNE, FRANCE.—Ferdinand Vallette, in GENIE CIVIL, vol. 108 (1936), No. 21, pp. 491–492.

At Bethune, where one of two French experimental plants for the synthesis of liquid hydrocarbon fuels is in operation, the finely pulverized coal is suspended in a heavy oil of some sort ("supporting" oil) in a special resistant steel tube, and through this suspension hydrogen under a pressure of 200 kg. per square centimeter is bubbled so as to agitate the mass while the temperature is being progressively raised. The tubes are arranged in vertical bundles that line the walls of a coke furnace, the top of one tube being connected by a suitable pipe with the bottom of the next, the arrangement being similar to that of a train of laboratory wash bottles. As the temperature reaches 350 deg. C. the coal begins to fuse and partly dissolve in the supporting oil, so that the mixture acquires the character of a liquid phase. The hydrogenation reactions occur at 470 deg. C.; in this "liquid phase hydrogenation" no catalyzer is used. The products resulting from this first stage on leaving the furnace are automatically separated, by cooling, into three fractions. A first cooling separates the volatilized high-boiling constituents, which includes part of the volatilized supporting oil; the second cooling produces a sort of crude petroleum; the third fraction consists of lighter oils and gases. The residue and heavy products of the first fraction have the appearance of a tar, and are returned to the furnace as supporting oil after receiving a fresh charge of coal. To avoid accumulation of coal ash and free carbon in the reaction mixture, a part of the residue is subjected to a complete distillation to recover all the supporting oil and a tar rich in ash; this tar serves for the manufacture of hydrogen by the water-gas process. An important point in this process is not to destroy too much of the supporting oil; the operations are therefore balanced so as to produce 400 kilograms of light oils per 1,000 kg. of coal and to obtain all the necessary hydrogen from the residual tar.

The fraction boiling under 300 deg. C. is separated into a fraction boiling between 300 deg. and 270 deg. C., and lower boiling prod-

ucts which are put through the usual fractionating and refining processes. The 270 deg.–300 deg. fraction is then hydrogenated in vapor phase so as to produce the largest possible proportion of liquids usable as gasoline.

This process thus does not differ in essentials from the Bergius process except in the matter of the reaction vessels. Where the Bergius process uses heavy chambers of large volume, the Bethune process employs tubes of small diameter. These tubes can be obtained from the stocks of manufacturers of special steels; they are interchangeable and easily renewed.

The gasolines obtained by this process are composed mostly of benzene hydrocarbons, with specific gravity of 0.84 and octane number 76 to 82; they contain no aliphatic hydrocarbons of kerosene grade or higher. The process appears to be well adapted to treating French lignites for which no other rational use has been found, and which can be hydrogenated at a lower temperature than ordinary stone coal. The plant now in operation has a capacity for working 50 tons of coal a day.

COMMERCIAL ASPECTS OF THE UNITARY THERMAL POLYMERIZATION PROCESS.—J. S. Carey, in REFINER, vol. 15 (1936), No. 12, pp. 549–554; 576.

The unitary thermal polymerization process, as licensed by Polymerization Process Corp., employs no catalyst, accomplishing the conversion of lower-boiling hydrocarbons from refinery residue and natural gas into motor fuels by the use of heat and pressure in a single continuous conversion coil. The materials converted are principally C_3 and C_4 hydrocarbons, and it appears that appreciable quantities of C_2 hydrocarbons are also converted in normal commercial operation. The charging stocks may be either entirely saturated hydrocarbons from natural gas and gasoline operations, or mixtures containing appreciable quantities of unsaturates as obtained from refinery gas.

The design of plant for commercial operation of the process depends on local conditions, and is governed by the degree of necessary recycling of the C_3 and C_4 hydrocarbons introduced as fresh feed. Where a large excess of butanes is available it is advisable to retain for recycling only those components that are condensible with the available cooling water. Whether to recycle C_3 hydrocarbons will be dictated by economic considerations.

For a plant producing 1,500 bbl. of polymer gasoline from a liquefied stock containing 30 percent C_3 H_8 and 70 percent C_4 H_{10}, all saturated, the direct cost is figured at 1.08 cents per gallon, and total costs at 2.21 cents a gallon. The product has high volatility (30–50 percent at 158 deg. F.), high octane number, 77–78 C.F.R.M., and responds very easily to vapor phase clay treating. The gasoline produced is predominately paraffinic except where the unsaturate content of the feed exceeds 55 percent. A considerable proportion of the paraffins are isoparaffins.

OBTAINING HYDROGEN FROM GASES CONTAINING METHANE.—W. A. Karzhavin, before International Congress for Chemical Engineering, 1936 (London).

The current methods for obtaining hydrogen from natural gas and other gases containing methane are briefly reviewed. These methods are based on the reaction of methane with steam at high temperatures to produce carbon monoxide and hydrogen. As this reaction is a slow one it is necessary to use high temperatures (up to 1,300 deg. C.) and a catalyzer. So far, the most suitable catalyzer for the purpose is nickel which has been precipitated on refractory clay; such a catalyzer is long lived. In case the gases do not contain more than one gram of sulphur in one cubic meter, no preliminary purification of the raw gas is necessary.

The author's experiments were made with an apparatus for producing up to 500 cubic meters of converted gas per hour. The gas-steam mixture enters a reaction chamber previously heated to 1,050 deg. to 1,100 deg. C., where the methane is transformed into CO and hydrogen. As this endothermic reaction has a cooling effect on the apparatus, in the next phase of the process a small amount of heat is supplied from an outside source. The cycle of reaction consumes about 12.5 minutes of which 2.5 minutes is occupied by the warming-up process. The accompanying table shows the average composition before and after the reaction.

	Before	After
CO_2	7.4%	9.0%
CO	0.0	22.0
H_2	0.0	64.0
CH_4	87.4	0.8
C_2H_6	3.3	0.0
C_3H_8	1.1	0.0
N_2	0.8	4.2
S (g/cbm)	0.1	—

The raw gas mixture enters the reaction chamber with a temperature of 350 deg. C. The reaction chamber is kept at about 1,100 deg. C. by admitting a little air or oxygen to burn a part of the gas.

MANUFACTURE OF PETROLEUM SPIRIT.—H. Weiss, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 158, pp. 779–783.

Three types of processes have been established industrially for polymerization of hydrocarbons in the United States:

(1) Universal Oil Company polymerizes olefines from cracked gases at 230 deg. C. and under pressure of 30 kg./cm.^{2} using phosphoric acid as catalyst.

(2) Pure Oil Company treats the same initial material under conditions of heat and pressure alone: to obtain in particular, branched hydrocarbons of octane number 78–80 by operating at about 500 deg. and 100 kg.; to obtain in particular aromatic hydrocarbons of octane number 85–105 by operating at higher temperatures 650–725 deg. and 10 kg.

(3) Philipps' Company is more interested in obtaining saturated hydrocarbons from natural gases. Conditions of temperature and pressure must be selected so as to effect simultaneously, cracking with the formation of active radicles and polymerization of these radicles.

Operating conditions 500–600 deg. and 120–180 kg.

THE MAGNOLIA COMBINATION UNIT.—George Weber, in OIL & GAS JOUR., vol. 35 (1937), No. 34, pp. 30–31.

The Magnolia refinery at Beaumont is said to have definitely shown the high efficiency and general superiority of large scale "combination crude units," and to have set a precedent in the current trend toward larger capacity fractionation and cracking units.

The unit in question combines crude distillation, viscosity breaking, cracking and finishing of products in one operation, working on East Texas, Electra, Iowa and light Lockport crudes. It comprises two furnaces, a crude flash tower, two combined evaporator and bubble towers and auxiliary units for flashing, stripping, depropanizing and stabilizing the finished products. One of the furnaces is of dual design, receiving the crude charge for initial heating and a crude gas oil charge for cracking. In this crude-oil, gas-oil furnace the two streams are heated in separate radiant sections and a common connection section is located between the combustion chambers. The other furnace is employed as a viscosity breaker for a reduced crude charge. The viscosity breaking and cracking furnaces are designed for four wall radiation with ½-percent molybdenum tubes in the final section. The furnaces are gas fired from both ends in parallel with the fire walls. Reflux and bypassing lines provide considerable flexibility. A total of six finished products are obtained in processing East Texas crude.

Petroleum Chemistry

VAPOR-PHASE HYDRATION OF ETHYLENE.—R. Harding Bliss and Barnett F. Dodge, in IND. ENG. CHEM., vol. 29 (1937), No. 1, pp. 19–25.

Equilibrium in the hydration reaction of ethylene to ethyl alcohol has been investigated at 7 to 11 atmospheres pressure and at 320 deg., 350 deg., and 378 deg. C. Results agree well with those of Stanley, Youell, and Dymock, and both sets of data are well represented by the equations:

$$\log_{10} K_p = 2100/T - 6.170$$
$$\Delta F^\circ = 28.20T - 9600$$

which refer to the reaction:

$$C_2H_4\,(g) + H_2O\,(g) = C_2H_5OH\,(g)$$

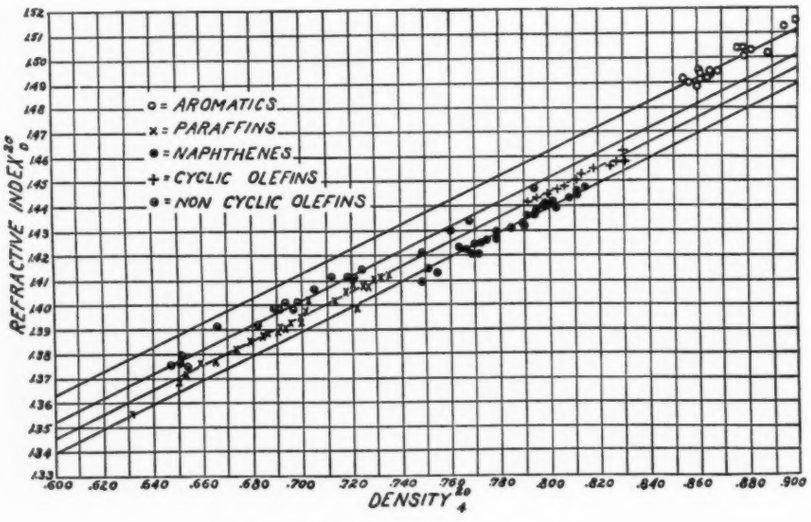
Some new observations on the behavior of various catalysts for the dehydration of ethanol are also presented.

ANALYSIS OF LIGHT PETROLEUM FRACTIONS.—S. S. Kurtz, Jr. and C. E. Headington, in IND. ENG. CHEM., analyt. edit., vol. 9 (1937), No. 1, pp. 21–25.

This paper describes a method for the determination of conjugated diolefins, cyclic mono-olefins, non-cyclic mono-olefins, paraffins, naphthenes or saturated cyclic compounds and aromatics in light petroleum fractions boiling from 40 deg. to 200 deg. C.

The method involves chemical treatment with maleic anhydride and sulphuric acid, fractionation into 30 deg. cuts, and measurement of density and refractive index of the cuts. Calculation of the results depends on graphical methods and is bettered by the use of a new constant called the refractivity intercept, which is the ratio between density and refractive index at 20 deg. C. (see accompanying graph).

The use of the refractivity intercept in the general analytical method depends on the graphical comparison of the density and the refractivity intercept of a chemically treated or untreated fraction with those of various hydrocarbon types of the same boiling range. For this purpose the refractivity intercept values for the hydrocarbon types are taken from a



Analysis of Light Petroleum Fractions

previously prepared table (given in the paper) and density values from other tables where density and boiling point have been correlated for hydrocarbons of several types. The three points thus found will form a triangle in the diagram: *refractivity index/density*, by which a desired point can be located. This graphical analysis is limited to three components, but the method can still be applied to mixtures of more than three components by resorting to chemical treatment to segregate three or less of these hydrocarbon types which can be analyzed graphically.

Conjugated diolefins are removed by treatment with maleic anhydride; removal of a three-component mixture composed of cyclic and non-cyclic olefins and aromatics is effected by treatment with 91 and 98 percent sulphuric acid. The procedure is described in detail. Boiling points and densities of a very large number of hydrocarbons are given.

NON-CATALYTIC ADDITION OF ETHYLENE TO PARAFFIN HYDROCARBONS.—F. E. Frey and H. J. Hepp, in IND. ENG. CHEM., vol. 28 (1936), No. 12, pp. 1439–1445.

In the experiments described a measured portion of propane or isobutane was circulated by means of a high-pressure pump through a heated tube. At predetermined time intervals small portions of olefin were injected into this stream to supply a steady, low concentration of olefins to the reaction zone. The olefin additions were continued until the desired quantity of olefin had been added. In run 266–12, a high-pressure flowmeter was substituted for the portionwise olefin addition arrangement, and the olefins were added continuously throughout the run (a substantially equivalent method of operation). After the last olefin addition, the reaction was continued for a time sufficient to circulate the hydrocarbon in the system once through the reaction zone. The products were then withdrawn from the system and analyzed.

The principal liquid product was a mixture of isomeric paraffins amounting to ½ to ¾ of the total liquid product. When using ethylene and propane about 75 percent of the liquid products were pentanes according to the reaction

$$C_2H_4 + C_3H_8 = C_5H_{12}$$

Replacement of secondary hydrogen of the propane by ethyl yields isopentane, replacement of primary hydrogen yields *n*-pentane. With ethylene and isobutane the products were chiefly hexanes.

While thermal polymerization of gaseous olefins to motor fuel ordinarily leads to the formation of a complex mixture of hydrocarbons, the use of favorable alkylation conditions makes possible the synthesis of isoparaffins of varying structure and molecular weight or volatility by the choice of suitable reactant paraffins and olefins. Such isoparaffins, particularly the more highly branched in structure, have high antiknock ratings and possess high stability, calorific value and lead susceptibility. These characteristics are particularly desirable in aviation fuel. Isoöctane (2,2,4-trimethylpentane) is a now familiar example.

The 2, 2,-dimethylbutane (a hexane) is such a paraffin. This hexane was the chief paraffin synthesized by reacting together ethylene and isobutane. By fractionating a quantity of the liquid product, a 2, 2-dimethylbutane fraction was separated for motor fuel tests. The fraction was essentially paraffinic, containing 1.9 percent olefin. The A.S.T.M. octane number of the fraction was 94.5 (unleaded), a little below that of isoöctane, and the volatility was somewhat higher.

Use of Petroleum

PROBLEMS OF MODERN HIGH-DUTY AERO ENGINES AND THEIR FUELS.—E. R. Banks, before Inst. Petroleum Technologists, London, January, 1937.

At the present time the greater proportion of high-duty engines in America and Europe are developed to employ fuels of 87 octane number containing tetraethyl lead (leaded fuels); this rating being determined either by the C.F.R. Motor Method or the modified Motor Method specified by the British Air Ministry. The latter test makes use of a mixture temperature of 260 deg. F. instead of 300 deg. F. in the former case. So far as leaded fuels are particularly concerned, there is a difference of approximately two octane numbers between the Motor Method and British Air Ministry tests; that is to say, a fuel of 87 octane by the latter test is equivalent to about 85 octane C.F.R. Motor Method.

The maximum amount of tetraethyl lead allowed in such fuels for commercial use is 3·6 ml. per Imperial gallon (3·0 ml. per U.S. gallon or 0·8 ml. per litre). For Governmental or military requirements this concentration may be doubled—that is, to approximately 7·0 ml. per Imperial gallon. In special circumstances the concentration may be increased to 4·5 ml. per Imperial gallon, for commercial fuels of 87 octane or higher.

The average amount of lead used in these fuels (of 87 octane) is generally in the region of 3·0 ml. per Imperial gallon, depending, of course, on the octane number and lead response of the basic spirit.

Recent developments in the U.S.A., on the part of the oil refiners, have enabled *iso*octane to be produced on a scale which allows it to be considered seriously as a constituent of aviation fuels. This material, as a chemically pure hydrocarbon (2: 2: 4-trimethylpentane), was originally found and developed by Graham Edgar as a primary reference standard, and is used with normal heptane, for determining the knock-rating of fuels in terms of octane number. Still more recent work has brought to light another blending agent, di*iso*propyl ether, which can be produced synthetically in adequate quantity.

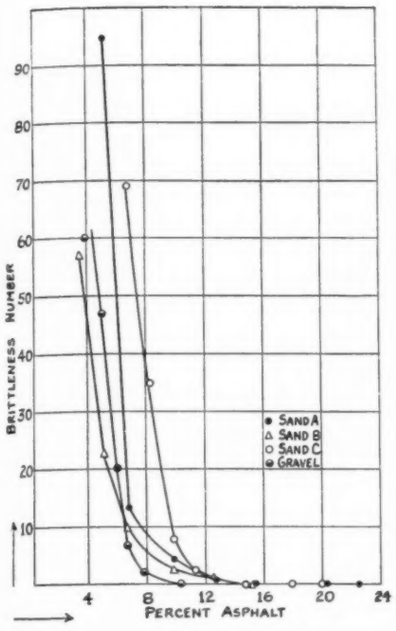
The author then goes into great detail to show how the engine manufacturers have endeavored to adapt their engines so as to develop the full capabilities of available fuels, particularly in the matter of avoidance of knock. As a hint to aero fuel manufacturers it is concluded since there is little possibility of producing a material, or fuel, which will not detonate at all, or cause pre-ignition, any new blending agents found in the future should be sensitive to additions of tetraethyl lead, otherwise their potentialities will tend to be considerably reduced and employment restricted.

Asphalt and Tar

SUGGESTED PROCEDURE IN DESIGN OF SHEET ASPHALT.—I. Bencowitz, in IND. ENG. CHEM., vol. 29 (1937), No. 1, pp. 98–105.

The procedure of design of asphaltic mixtures described consists first in determining the compositions of mixtures which possess a brittleness number between 0 and 2. This establishes the minimum asphalt to be used with a given aggregate. These mixtures are then subjected to a stability test to determine which of these has the highest stability. This differentiates between kind of aggregate, asphalt, and proportion of filler to sand. If the brittleness is measured at higher room temperatures (30 deg. C.), the range is reduced to 0–1.

The brittleness was determined in a machine which consists of a cylindrical drum, 24 inches (60.96 cm.) in diameter and 24 inches in length, mounted horizontally on shafts welded into the ends of the drum. The shaft does not go through the drum. On the inside of the drum is welded a shaft, 4 inches (10.2 cm.) wide, from end to end parallel to the axis of rotation and bent at an angle to the shell so that at each



Suggested Procedure in Design of Sheet Asphalt

revolution the specimen is picked up once, carried to the maximum height, and allowed to fall freely. It rotates 27 r. p. m. The shell is perforated with six rows of ⅜-inch (9.5-mm.) holes so that all fines are allowed to sift through, thus avoiding any cushioning effect and abrasion. The specimen is introduced through a small door at one end.

The brittleness number is the percentage loss by weight after an hour of tumbling in the revolving drum. Representative numbers so obtained are plotted in the accompanying diagram against percentage weight of asphalt. Each curve has a well defined "knee" which extends over a range of two or three percent of asphalt and the branch to the left rises very abruptly.

The stability test consists of measuring the maximum load (in pounds) required to force a sphere ¾ inch in diameter into the specimen to a depth equal to the radius (⅜ inch). The load is applied in uniform steps at the rate of ½ pound every 10 seconds, and the temperature of the specimen is maintained at 60 deg. C.±0.2 deg.

This procedure precludes the necessity for a priori knowledge of the service records of given mixtures in so far as the brittleness and the stability are concerned. The author realizes, however, that the design of a successful asphaltic paving mixture is exceedingly involved and that many factors are determined by neither the stability nor the brittleness. The ultimate test must be a large-scale road trial.

Yet the fact that these tests determine compositions which show low brittleness and high mobility under the heaviest load may guide the research man working with new asphalts or modified asphalts in deciding which of the compositions are best and help him to vary the constituents so as to obtain the best possible composition. The highway engineer, on the other hand, may decide by means of these tests whether a new mixture holds sufficient promise to justify large-scale trials.

Petroleum Substitutes

Coal Hydrogenation.—M. Pier, in IND. ENG. CHEM., vol. 29 (1927), No. 2, pp. 140–145.

In this paper an engineer of the I.G.-Farbenindustrie A.G. outlines the process of coal hydrogenation and makes a comparison of hydrogenation products of coal and oil. In comparison with petroleum, only a relatively small amount of liquid material may be produced by the thermal treatment of coal; this is due to the fact that petroleum contains twice as much hydrogen as coal, and also that in the decomposition of coal some of the hydrogen is consumed by the abundance of elements such as oxygen, nitrogen and sulphur. Hence low boiling products are formed to an insignificant extent, so that economical carbonization of coal requires finding a way to utilize the large quantity of the by-product coke that is produced. To get around this difficulty the Germans have developed catalytic destructive hydrogenation of coal at elevated pressure to a point where the raw material is almost completely converted into low boiling products, without the necessity of producing a large amount of high-boiling or even solid condensation products.

There are two processes in use: the direct hydrogenation of coal and the hydrogenation of coal tar that has been obtained in the manufacture of coke. The 15 percent of tar obtained from German high-bitumen lignites is converted into motor fuel with the aid of hydrogen obtained by treating coke from the same coal by the water-gas process. The joint result of these two processes is that the production of motor fuel from coal in Germany does not depend on the salability of by-products, and waste of raw material is avoided. Gas is practically the only by-product and this gas may easily be reconverted into hydrogen, thus assuring a full supply of this element for hydrogenation purposes. The processes are flexible, so that it is possible to arrange for a great variety of final products from a great variety of raw materials.

The process of the I.G.-F. depends on addition of hydrogen to the raw materials at high pressures in the presence of catalysts immune to sulphur poisoning; these catalysts are of different kinds and forms according to the object in view. Hydrogenation is effected in both the gaseous and the liquid phase (solid carbon is indirectly hydrogenated in the water-gas process). Some of the catalysts have extremely long lives—more than a year. Hydrogenation in the gaseous phase was developed first, but hydrogenation in the so-called "sump" or liquid phase with a small amount of finely distributed catalyst is especially important at present. The process is essentially the same whether tar or the original coal is being hydrogenated; the material is a liquid or a solid suspended in a "carrier oil". Ash in the coal is a source of trouble; it is removed as much as possible by washing the coal; what is not removed in this way is separated by centrifugaling the crude reaction product from the hydrogenators. Another method of getting rid of the ash is the coal extraction process, wherein the coal is dissolved at high temperatures by solvents (tetraphydronaphthalene or phenol) and the insoluble ash is removed by filtration.

Different kinds of coal yield different kinds and amounts of products—asphalts, heavy and light oils, so the range of final products it is desired to make is very wide. Nevertheless, the same types of equipment can be used practically unchanged with any of the various raw materials and for the production of the different final products. This is the great advantage of the hydrogenation process as compared with other methods of obtaining gasoline and lubricants from coal.

Hydrogenation.—F. S. Sinnat and Angus McFarlane, in IND. ENG. CHEM., vol. 29 (1937), No. 2, pp. 133–140.

This is a report from the British Fuel Research Station. The general problem of this Station has been to ascertain whether the bituminous coals of Great Britain could readily be converted into gasoline. The work, started in 1923, has culminated in the erection of a plant capable of producing 43,000,000 gallons of gasoline a year. At the present time the station is making a comprehensive study of the characteristics of coal seams, which seem to vary considerably in their adaptability to hydrogenation in continuous and intermittent processes.

The commercial success of coal hydrogenation in England depends very largely on finding a market for the coke that is formed when coal is subjected to low-temperature distillation, so the Department of Scientific and Industrial Research is making an effort to provide the British householder with a smokeless, free burning coke that produces a very pleasant fire in an open grate; this is held as being one way to mitigate the evils of the famous British fogs.

The tar produced at the rate of 20 gallons per ton by carbonization of bituminous coal in specially designed brick retorts at 650 deg. C. contains 57.8 percent of products that distill below 360 deg. C. and 41.7 percent boiling above 360 deg. C.; of these products 19.3 percent consist of tar acids, 1.2 percent of tar bases and 37.3 percent of neutral oils.

In order to convert this material into gasoline it is necessary to eliminate the sulphur and reduce the acids and bases to hydrocarbons, besides reducing the boiling points of the neutral oils below 200 deg. C. For these reasons the tar has to be both hydrogenated and cracked, and the secret of coal hydrogenation appears to consist in promoting a proper balance between these two types of reactions. Reaction begins at about 320 deg. C.; after 370 deg. C. the tar loses its black appearance, becoming dark orange at 410 deg. and pale, transparent yellow at the normal working temperature of 480 deg. C. The working pressure is 200 to 400 atm., with the optimum at 200 atm. and 450 deg. C. Molybdenum compounds have been the most satisfactory catalysts.

The operating procedure has been more or less reduced to forcing hydrogen into the tar and passing the mixture first through a preheater and then through a long pipe serving as the converter or reaction chamber. The products pass into separators where gases, liquids and solids are separated. The hydrogen and the oils that remain in excess are recirculated. The general conclusion is that the problem of converting low temperature tar into gasoline by hydrogenation in a single and economically more advantageous operation is far on its way to complete solution.

Preparation of Phenol and Cresol from Gasoline.—V. Cerchez and A. Schuper, in MONITEUR PETROLE ROUMAIN, vol. 38 (1937), No. 2, pp. 97–100.

Roumanian crude oil, containing considerable amounts of aromatics, were used as a source of high explosives by the Germans dur-

ing the Great War. For this purpose it has been considered necessary to separate the aromatics (benzene and toluene) by a careful fractionation. In the present work an attempt was made to obtain these aromatics by skimming crude oil and sulphonating the fraction up to 80 deg. C. for benzene and the fraction 95 deg.–110 deg. for toluene, using hot concentrated sulphuric acid.

It was found that the yield of sulphonated product depended on a high ratio of acid to hydrocarbon mixture. The largest yield, 54 percent, was obtained when the proportion of gasoline was 280 grams to 184 grams of acid. The reaction is never complete in batch operations but may be so in counter-current operation. Preparation of the free phenol and cresol then follows the usual course.

Petroleum Economics

Effect of Gravity on Cost of Processing Mid-Continent Crude Oil.—W. L. Nelson, in REFINER, vol. 15 (1936), No. 2, pp. 372–373.

Many refiners feel that a high-gravity crude oil is far superior to a low-gravity crude oil, and the same is indicated by the pricing of crude oils by gravity. However, the following analysis does not bear out the above except perhaps that the lighter crude oils can be handled in a simple plant which does not entail a large capital investment. The small investment required to process light crude oil encourages many small refiners to prefer the light oil and doubtless accounts in large part for the general opinion that these oils are most valuable. Another factor which may make the lighter crudes more desirable is the fact that they usually contain less sulfur than the heavy oils. The above statements are based on the assumption that either topping and cracking or complete processing is practiced. It is assumed that simple topping or skimming is no longer profitable except under rare market conditions or in isolated vicinities.

The former importance of the gasoline content has been nullified to a large extent by the demand for high-octane motor fuels. This demand has increased to such an extent that the disposal of the straight-run gasoline that is contained in the crude oil has become a problem. The problem is met by reforming all or part of the straight gasoline by means of an operation similar to cracking. In terms of plant operation it means that a cracking operation must be used for essentially all of the crude oil except the lubricants, regardless of how much gasoline the crude oil contains. And in other words, the expense of cracking a heavy crude oil is little more than the expense of cracking and reforming a light crude oil. For very light crude oils the amount of reforming frequently exceeds the amount of cracking that is practiced.

In the manufacture of lubricating oils, the heavy oils are again preferable because of the large percentage of heavy stocks contained in them. However, it is not uncommon to find that the heavier crude oils tend to have asphaltic properties and thus to yield less valuable lubricating oils than the lubricants from light crudes.

From this standpoint cost analyses are given of three types of processing: (1) topping and cracking; (2) topping, cracking and reforming; (3) complete processing Mid-Continent crude oil. The result is that, with the exception of (3), while processing costs are lower for the light crudes, the higher market cost of these light crudes leaves less profit than when processing the heavy crudes.

Can the Rule of Capture Be Rationalized?—Earl Oliver, before Amer. Inst. Mining Metallurgical Engineers, New York, February, 1937.

Efficient extraction of oil and gas at the time and rate society needs them, together with equitable allocation of these products and the markets for them among their respective owners, are the two major objectives of the petroleum industry. Stability within the industry is dependent upon accomplishing both of these objectives. However, simultaneous accomplishment of both objectives under the capture rule is impossible. It is, therefore, mechanically impracticable. It promotes high cost, waste, and inefficient recovery to a degree that compels the granting of subsidy through tariff protection to keep the industry solvent. It is therefore economically inadvisable. The rule of capture cannot be rationalized. It is inherently in conflict with the functions of government, and the higher impulses of mankind. It is a destructive influence.

On the other hand, ownership in place is the direct antithesis of the capture rule in every respect mentioned. It tends to build up, while the capture rule tends to tear down. It has for its orderly administration every process of ownership devised through the centuries. In its application two methods of allocating the product among owners are available, namely, the mechanical separation method in nonunitized pools and the engineering appraisal method in unitized pools. Neither method would be mathematically accurate, but both can be made to do substantial justice among owners and come within standards set by the law. Both are incomparably better than the capture rule to attain that end.

Latent California Oil Reserves.—B. Mills, in OIL WEEKLY, vol. 84 (1937), No. 10, pp. 39–42.

Various considerations lead to the conclusion that further supplies of oil in California (aside from discovery of entirely new fields) is largely a matter of deeper drilling. It now appears that in no known major field of the State has any full horizon above the basement complex failed to be productive when tested through its entire thickness; thus the basement complex is the limit of hope in most fields. It is true that some of the lower formations may yield a type of production that will not prove as profitable as some of the shallow and intermediate formations, but apparently hope need not be given up until the basement complex has actually been reached. Even in the Ventura Avenue field, where the deepest production in the world has been reached, all developments so far have not penetrated below the Pliocene; the Miocene, the Oligocene and the Eocene, which have been more or less productive in other California fields, are no doubt still below the bottoms of the deepest Ventura Avenue wells; the author believes that oil-bearing horizons will be found here at depths beyond 20,000 ft.—if future drilling methods allow of going that far down. At any rate, production in California to date has largely been a matter of going down to deeper and deeper oil-bearing zones. In the Santa Fe Spring field, for instance, production has been had from seven distinct zones, and there is still definite promise of yet deeper oil-bearing horizons in this field. The same is considered to be true or probable of the Long Beach, Huntington Beach, West Coyote, Montebello, Inglewood, Ventura Avenue and Kettleman Hills fields.

Books

Gulf Coast Oil Fields.—Edited by Donald C. Barton and George Sawtelle; published 1936 by American Association of Petroleum Geologists, Tulsa; 1,100 pp., 292 figs., 19 halftone plates, 6 x 9 inches. $4.00.

This large volume is what the editors describe as a symposium on the Gulf Coast Cenozoic. It consists of forty-four papers contributed by fifty-two authors. Most of these papers have appeared in the *Bulletin* of the Association during the period 1933–36. It is a natural successor to an earlier symposium, entitled GEOLOGY OF THE SALT DOME OIL FIELDS issued in 1926. In both these valuable works the aim has been to give geologists a comprehensive picture of the American salt domes, of the oil fields on them, and the theories of their origins.

In the present work, aside from a foreword by Donald C. Barton, and a paper by the same author on the reading of an aerial map of Barber's Hill, there are 14 general and theoretical papers dealing largely with the mechanics of salt dome formation, structural features of salt domes, relation of geophysics to salt dome structures, and related topics. There are ten papers on stratigraphy dealing with the Vicksburg, Claiborne, Post-Fleming and Jackson groups, the tertiary stratigraphy of Louisiana, and various other areas that are specially treated. There are 20 papers describing as many oil fields and salt domes, four in South Texas, ten in southwest Texas, five in southern Louisiana and one in East Texas. A voluminous index completes the book.

The editors make no pretense that this suite of papers presents more than a fair sample of the newer information which now exists in reference to the Gulf Coast, but this reviewer can testify that as a sample it does very well.

A Welding Symposium.—By various authors; No. 4 of Journal of the American Society of Naval Engineers (1936).

This is a collection of seven papers that cover in broad lines the application of welding to various structures and for various purposes. Norman L. Mochel contributes a retrospect of ten years of welding development, with special emphasis on the use of welding in marine engineering construction, with generally applicable comment on technique and material. In a chapter on welded structures Everett Chapman deals with the important characteristics of the parent metal. The repair of steel castings is discussed by Hugo W. Hiemke, in which the importance of radiographic examination to detect flaws and to salvage large castings by remedial welding is pointed out. The welding of pressure vessels is treated by James

Campbell Hodges, particularly fired pressure vessels, treating of work of the highest class and safeguards which have been found most efficacious. A discussion of automatic and manual electric arc-welding is contributed by A. J. Moses; who shows a strong preference for manual welding over automatic welding, pinning his faith very largely on a proper processing of the welding rod. Fusion welding is treated by Bela Ronoy, who here assembles most of the known facts and many of the more reasonable theories of fusion welding with the electric arc; his article could serve in some degree as a practical manual of the art. In an article on naval welding process approval tests, Wm. C. Stewart assembles for the first time the scattered information and instructions issued from time to time by the Naval Bureau of Engineering.

The work as a whole is a useful and enlightening compendium on the welding art.

General

Education and Training for the Oil Industry.—A. W. Nash, in jour. inst. petrol. technologists, vol. 22 (1936), No. 158, pp. 790–797.

The author points out that the remarkable growth of the petroleum industry has caused the proper training of personnel to become of increasing urgency. Modern developments have led to the utilization of geologists, geophysicists, production engineers and chemical engineers, so that the petroleum industry requires its technical men to have had a specialized vocational training. It is observed that petroleum technology cannot be taught as a "top-dressing" to other vocational subjects with any degree of success. The author sets out the main lines for the study of petroleum technology, which should lead to specialization in one of the three main branches of the industry—geology, production, or refining. Such specialization, however, could only be satisfactory when based on a thorough knowledge of the fundamentals of physics, mathematics and chemistry, and of the general principles of engineering and chemical engineering. An account is then given of the ground to be covered in these subjects, and insistence is laid on the necessity for teaching the student to apply his knowledge, to use the literature to find new information and to interpret and use it for the solution of difficulties. The author concludes that in the petroleum industry the qualified graduate will find one that is unequalled in its capacity and in the opportunities of advancement offered to enthusiastic and properly trained men, an industry, moreover, which has the advantage of having been developed from its early days upon true scientific lines.

Percentages of Recovery.—V. G. Gabriel, in oil weekly, vol. 84 (1937), No. 8, p. 35.

The question of the percentage of recovery of oil from underground is among the controversial questions in oil evaluation. Some claim that the average recovery of oil does not exceed 20 percent of the total capacity stored underground, whereas some technicians believe that 60 percent recovery can be obtained under favorable conditions. Deussen, in his interesting paper on the acre-foot yields of Texas Gulf Coast oil fields states: "Most authorities will agree, I believe, that it does not in general exceed 40 percent."

This wide variation in the determination of the percentage of the recovery of oil from the oil pools is due to the presence of many variable factors which greatly influence the final determination. At first glance, the evaluation of the percentage of recovery is simple, especially in dealing with nearly exhausted oil reservoirs, because in this nearly ideal case, the total amount of oil produced, divided by the total amount of original reserves considered to be stored underground, gives the percentage of recovery of oil from underground.

Algebraically it can be expressed as,

$$\frac{\text{total pr.}}{7758 \times P \times S \times T \times A} = \%\ \text{of recovery}$$

where

total pr. = total production in bbls.
P = porosity %
S = saturation %
T = thickness in feet
A = number of productive acres
7758 = a constant

A reference table is given, showing percentage of recovery per acre foot in barrels for different percents of saturation and different percents of porosity.

Recovery of Oil from Alberta Sand.—L. G. E. Bignell, in oil & gas jour., vol. 35 (1936), No. 31, pp. 37–38.

A plant for extracting oil from the great deposit of Athabaska oil sands is now in regular operation and is working 250 tons of sand per day. The oil occurs as a film surrounding the individual sand grains; the amount of oil may run as high as 25 percent by volume and averages 14.7 percent. The first step is to mix the sand in a pug mill with hot water which contains a small quantity of sodium silicate in solution; the mixture then passes into a "flotation cell" in which the oil separates from the sand. The oil, however, having a specific gravity of 1.02 separates with difficulty from the water, so the emulsion is extracted with kerosene and the oil is subsequently separated from the kerosene by distillation.

One significance of this development is that it suggests a means of working old oil sands that have ceased to flow by any natural or artificial means. In the distant future when no new oil fields are discovered the exhausted oil sands will have to be mined and the oil recovered by some such flotation process as the one here described. These Canadian sands contain about 300 bbl. of oil to the acre-foot, which is about the same as the quantity left in many sands from which no more oil is recoverable.

Strengthening the Vibrational Resistance of Threaded Metal by Surface Pressing.—W. Isemer, in mitteilungen des wohler institues, No. 8 (1931).

It is a well-known fact, verified both by practical experience and by laboratory investigations, that in the construction of power transmitting mechanical appliances abrupt differences in cross section should be avoided, because it is at such places that differences in strain will be most increased. Breaks will occur at these transition points before the strain in the other parts, where the cross section remains uniform, has reached the breaking point. The matter is not so important where the construction is subjected only to a static stress, because when the elastic point is exceeded the part concerned will expand or stretch and thus transmit part of the tension to the adjacent parts. On the other hand, abrupt changes in cross section are especially dangerous in a mechanical appliance that is employed under conditions which affect its resistance to vibrational strains. Since under vibrational conditions there is very little plastic deformation of the most severely affected parts, there is little opportunity for an equalization of the tensions by transferring part of the strain to adjacent portions of the mechanism. Consequently the vibrational resistance of the part as a whole is markedly reduced.

The changes in cross section need not be very marked to have a large importance. It is known that small scratches, scarcely visible to the eye, may greatly reduce the resistance of a rod to vibration, and may give rise to premature breaks in operation. A realization of the damage that may come from the presence of small scratches occasioned by machining operations has led to the practice of subjecting machined surfaces to rolling pressures heavy enough to fill the scratches by plastic flow of the metal, thus restoring uniformity of cross section.

Among machine parts that exhibit the most abrupt changes in cross section are threaded rods and tubes, and it is notorious that it is in the threaded parts that breaks most frequently occur when rods and pipes are subjected to vibrational strains. The threaded parts are weakened not only by the presence of the threads, but also by the form to which the threads have been cut. Where the thread grooves have a V-form, that is, where the sides meet to form an angle and thus present an abrupt change in cross section, the most favorable condition is provided for the development of the most severe vibrational strains.

These considerations point to the desirability of cutting the threads of pipe so that they will have rounded instead of V-shaped bottoms. It is important that the thread-cutting machine not only produce the right form of groove, but that the tool leave no fine scratches. This last mentioned condition is nearly impossible to fulfill. The hardest and sharpest tool will tear the machined part more or less, leaving cracks and scratches of greater or less extent on the machined surface.

The obvious answer to this condition is to fill up these cracks and scratches by plastic flow of metal produced by a rolling pressure in the grooves. The efficacy of this operation was first proved by Isemer in an investigation that has not attracted as much attention as it seems to deserve. Isemer threaded sections of rods of different steels and other metals and subjected these rods to vibrational stresses in a flexing machine until a permanent crack appeared. Where the thread grooves had not been rolled after cutting the break invariably appeared in the threaded portion; where the thread grooves had been rolled the break appeared outside the threaded portion.

These results appear to point to the desirability of cutting threads to a round bottom, and then rolling to produce a crack and scratch-free surface. The pressure applied by Isemer to the single roll amounted to 3,963 pounds; for best results the roll should pass 15 times back and forth along the grooves. In this way Isemer proved that the vibrational resistance of his threaded rods could be increased 20 to 65 percent.

(Note.—This seems to be of great importance to users of oil well pipe. Ed.)

In spite of her huge underground oil reserves, Russia finds it necessary to import high-test gasoline for domestic use and military reserves. Photo shows the BATUM, *Soviet tank motorship, taking on 80,000 bbl. of gasoline in Santa Monica Bay, California, for delivery at Vladivostock.*

SIMPLIFIED REFINERY PIPE FITTINGS

DEVELOPMENT of new type pipe fittings may eliminate some of the difficulties of threading, grooving or screwing up joints in cramped quarters around the refinery.

Plain end pipe is inserted into the completely assembled fitting, two threaded octagonal follower nuts are tightened with a few turns of the wrench and the coupling is completed. Tightening the nuts compresses armored gaskets around the pipe forming a positive seal which is capable of absorbing normal vibration, expansion and contraction.

This new line of fittings is announced by the S. R. Dresser Manufacturing Co., 853 Fisher Ave., Bradford, Penn., and should find wide application around the refinery as other Dresser Couplings have in pipeline work.

▼

PETROLEUM produced by the Rafidain Oil Company (a subsidiary of the Anglo-Iranian Oil Company) in Iraq, who operate the Khanakin oilfields, totaled 91,900 tons (643,300 bbl.) during 1936. The entire output was used in Iraq. The Rafidain supply motor vehicles, engines, and aircraft with petrol.

GULF EXPORT PRICES FOR MAJOR OIL PRODUCTS

Products		Cents per Gallon			
		Jan. 20	Jan. 27	Feb. 3	Feb. 10
Gasoline:	U. S. Motor	5½	5½	5½	5⅝
	64/66–375 E.P.	5¾	5¾	5¾	6
	59 Octane & below	5½	5½	5½	5¾
	65 Octane & above	5⅞	5⅞	5⅞	6⅛
Aviation Gasoline: (Tank-car F.O.B. Ref.)	73 Octane & above	10	10	10	10
Kerosene:	44 w.w.	5¼	5¼	5¼	5⅜
	41–43 w.w.	5¼	5¼	5¼	5¼
	41—43 p.w.	5	5	5	5
Gas Oil:	26–30 translucent	3¾	3¾	3¾	3¾
	30 plus translucent	4	4	4	4
Fuel Oil:	Grade C Bunker (per bbl.)	$ .95	$ .95	$1.00	$1.00
	Cargo lots (per bbl.)	.95	.95	.95	.95
	Diesel oil (per bbl.)	1.65	1.65	1.65	1.65
Lubricating Oil: (New York Export Market)	Bright Stock No. 8	28	28½	29½	29½
	Bright Stock No. 6½	27½	28	29	29
	600 Warren E.	23	23½	24	24
	600 Unfiltered s.r.	20½	21	21½	21½
	650 Unfiltered s.r.	22	22½	23	23
	600 Flash s.r.	23	23½	24	24
	630 Flash s.r.	24	24½	25	25
	Neutral 200 No. 3	30	30	30	30
	Neutral 150 No. 3½	26½	26½	26½	26½
So. Texas:	Red oil 500 No. 5–6	7¼	7¼	7¼	7¼
	750	8¾	8¾	8¾	8¾
	1200	8¾	8¾	8¾	8¾
	Pale oil 500	7½	7½	7½	7½
	750	8¾	8¾	8¾	8¾
	1200	9	9	9	9
Crude Oil:	East Texas crude delivered at Gulf port for export (per bbl.)	$1.37½	$1.37½	$1.50	$1.45
	Venezuela crude (per bbl.)	1.05	1.05	1.05	1.05
	Trinidad crude (per bbl.)	.90	.90	.90	.90
	Panuco crude (per bbl.)	1.10	1.10	1.10	1.10

U. S. S. R.

Official Figures for Soviet Oil Operations

	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
January 1937	16,100,000	519,355	14,750,000	480,000
January 1936	16,155,300	521,139	13,933,000	509,950
Total 1936	191,911,200	507,960	171,269,500	6,952,222
Total 1935	176,688,100	497,713	146,705,000	4,868,465
Quota 1937	241,500,000	661,644	191,500,000	8,200,000
Quota 1936	213,500,000	584,931	175,000,000	7,100,000
Quota 1935	212,310,000	581,672	171,500,000	5,214,000

Crude conversion: seven bbl. = one ton

THE Soviet oil industry has started the year with decidedly poor showings. Crude production and drilling operations during January are not only below the corresponding figures for December but also below the figures for January, 1936. Plan fulfillment for January shows arrears of about 15 percent; however, similar arrears against the plan are to be noted in almost all branches of Soviet Heavy Industries with the exception of the output of tractors, which shows 1.3 percent in excess of the plan. In January, 1936, almost all Soviet Heavy Industries had not only fulfilled the quota but had operated from 5 to 15 percent ahead of the plan. The usual Soviet practice of making a Stakhanov drive during the last quarter of each year in order to fill out the gaps and arrears of the plan incurred during the year, and of strengthening the upswing with a view to attaining new heights during the first quarter of the new year, has apparently failed in January of this year. The Stakhanov drive to speed up operations during the end of 1936 has evidently exhausted the human forces and has automatically brought about a period of involuntary relaxation. Moreover, the various trials and tribulations of the past year have resulted in many shortcomings in the form of bureaucracy, inefficiency and negligence which will have to be uprooted and stamped out before effecting another upswing.

The 15 percent arrears incurred by the Soviet oil industry during January are due not only to shortage of production in Soviet oil fields outside the Caucasus, but to failure in the Caucasian fields as well. This was especially true at Baku where almost all oil field groups failed to live up to plans with the exception of the Lenin, Kirov, Stalin and Aliati groups, where plan or excess-plan fulfillment was registered on a few individual days during the beginning of the month. Baku fields were scheduled to produce some 434,000 bbl. of crude per day, but actually produced between 42,000 and 45,000 bbl. per day less. Some of the major fields produced 10,000 to 15,000 bbl. less than required for plan fulfillment. Other Baku fields were not able to complete any new wells for operation owing to cave-ins at wells during drilling and production of these fields dropped about 50 percent.

The quota for the first quarter 1937 for the entire Soviet oil industry called for a total of 59,400,000 bbl. of crude and 2,145,000 feet of drilling; or almost 20,000,000 bbl. of crude and 715,000 feet of drilling per month.

During January these quotas were not fulfilled either in production or in drilling. Weather conditions were hardly favorable for operations; in the middle of the month and again at the end snow storms raged over Baku oil fields and disrupted all operations. During the first snow storm operations at over 200 oil wells were disrupted and 120 drilling outfits were out of order. The fields were not prepared for inclement weather and before any protective measures could be taken against a recurrence the second snow storm again wreaked havoc with operations; about 60 rigs were uprooted, 340 deep pumping wells and 60 compressor wells were put out of order and production fell immediately 25,000 bbl. per day. Transportation was tied up when several small gauge rail lines became impassable. Terrific storms also ravaged over the entire Black Sea region and the temperature at Maikop registered 22 degrees C. below zero.

The individual Baku oil fields operated during January as follows:—Stalin group, 99–80; Molotov, 77–45; Kergez, 60–26; Lenin, 100–94; Kirov, 105–80; Asisbekov, 90–80; Artema, 82–60; Ordzonikidze, 100–90; Kaganovitch, 90–78; Aliati, 124–50 percent. The Grozni fields which are now subdivided into three major groups operated during the month as follows:—Molgabek, 13–12; Dagneft, 90–85; and October fields, 81–69 percent of the plan for the month.

Drilling was hampered by inclement weather. On individual days operations reached the lowest levels of the plan, such as 60 percent at Baku, 29 percent at Grozni, 42 percent at Maikop, 35 percent at Emba. Bashkiria, however, showed an excess of 10 to 17 percent.

ZA INDUSTRIALIZATIU of Jan. 11th, commenting on oil operations states that not a single Soviet oil field has operated satisfactorily and most of the Baku oil field arrears are due to failure to bring new wells under operation; further, the rate of repairs on wells temporarily idle was very low. The new Baku oil field group of Kergez, which was formed recently from the Kergez and Kiziltepe fields and further enlarged by the addition of the Shonger property, depends entirely upon production from new wells completed for operation, and not a single well has been completed in either of these properties. Cave-ins were encountered in drilling, this being difficult to understand since the evil of cave-ins has been so successfully solved at Biandovani, Pirsagat, etc., which are also properties of Baku.

According to an order issued in September, 1936, Kergez operators were to completely master all these new properties in 1937, produce not less than 4,500,000 bbl. of crude and drill and complete 164 wells. So far only two wells have been drilled and these not as yet completed. At Shongar three wells drilled have been completed for over three months, but are not operating as yet. Crude production which is about 50 percent of the plan has come from a few small producing wells of

Plan Fulfillment Soviet Heavy Industries

January, 1937

Tractors	101.3 percent
Electrical Power	95.6 "
Coal	92.8 "
Rolling Mills	91.7 "
Trucks	91.3 "
Sulphuric acid	90.3 "
Freight cars	85.7 "
Steel	89.8 "
Pig iron	85.5 "
Oil & gas	84.1 "
Raw copper	79.7 "
Locomotives	72.6 "
Drilling	61.6 "
Machine tools	57.1 "

Index Soviet Industrial Operation, 1932–1936

(Average daily output)

	1932	1933	1934	1935	1936
Electrical Power (million KWH.)	24.2	30.2	39.7	49.5	62.5
Coal (1,000 tons)	174.9	207.4	253.7	293.5	339.2
Oil & gas (1,000 tons)	60.5	61.3	70.0	73.4	79.7
Coke (1,000 tons)	23.0	28.0	38.9	45.8	54.3
Iron ore (1,000 tons)	33.1	40.0	59.8	75.9	81.5
Pig iron (1,000 tons)	16.8	19.4	28.6	34.2	39.3
Steel (1,000 tons)	16.1	18.6	26.1	34.1	44.3
Rolling mills (1,000 tons)	12.2	13.9	19.3	26.0	34.1

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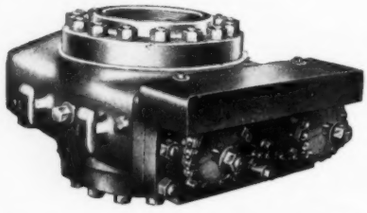

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Kiziltepe. The paper states further that the operators consist mostly of Baku oil men who are very experienced but also very conservative in regard to American methods and practice; hence the slow tempo of development. Conservatism breeds lack of initiative and flexibility; this accounts for the many months of delay while waiting for some super-modern equipment instead of modernizing the equipment at hand and drilling with stream or any power available. Some of the operators find a subterfuge for failures in the caprices of the subsoil, but the many gushers already opened point to the immutable fact that the operators have failed to study the geological nature of the undoubtedly existing subsoil resources. Likewise, in drilling the usual approach to the depths of these properties are doomed to failure because the tectonic requires special studies, and so far the operators fail to realize that distance drilled or even wells drilled without practical results contribute little toward plan fulfillment in actual production of crude.

At Pirsagat similar experiences were gone through when the field was discovered, but adequate studies were made of the tectonics and all secrets of the subsoil were discovered in time; no lessons, however, were learned and no hints taken.

At some distance from the Kergezneft properties three new regions—Sarincha-Gulbakh, Bozdagh and Karadagh—are scheduled for full exploration and prospecting as well as for production in 1937. For this not only drilling and completion of wells are required but also actual results in production; at present this does not appear very likely because of poor showings in exploration. The finest examples of how to approach exploration of new oil regions were given to the oil operators by S. Ordzonikidze. His orders and recommendations in regard to operations at Lokbatan, Pirsagat of Baku, Izberbash of Grozni, and Sterlitamak or Krasnokamsk of the Urals were the most practical examples of how to study the geological properties of new oil regions in order to succeed in production. Izberbash, which was given special attention by Ordzonikidze, has now yielded the third gusher since discovery of the field. Most of this property consists of tectonics of a thrusted anti-clinical nature situated under the bottom of the Caspian Sea. This part is now considered as the original field. However, another part of the field closer to the dome formation is situated on land and the oil layers are 700 to 1,000 ft. deeper than those in the area under water. The field on land is the second region and is now considered favorable for at least 150 producing wells. On the original field seven prospecting wells are in drilling, all of which have now reached the productive layers and it looks as if this field will have an area of about 700 hectares, of which about one-half will be on land. Over the second field three prospecting wells are being drilled and from studies and tests made it seems likely that this area will prove not inferior to the original field in deposits or resources.

The Ordzonikidze order of September also stipulated exploration of eight new oil regions at Emba. During 1936 exploration operations at Emba were not satisfactory and still less

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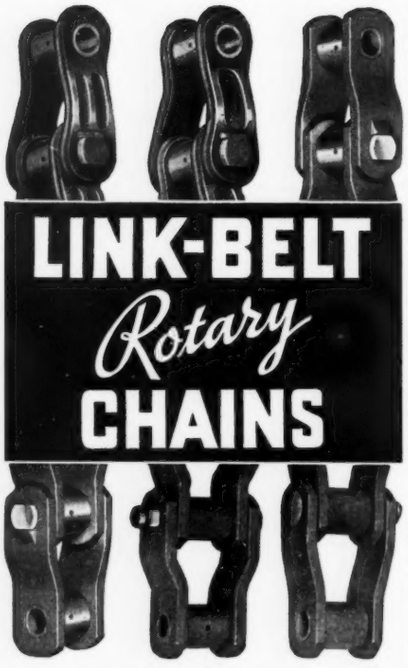

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satisfactory were the results of efforts to bring new wells under production. At present 10 wells completed in drilling have been awaiting testing since October, 1936. Owing to this delay it is, of course, out of the question to make any estimate of the potentialities of the newly discovered horizons. Stakhanov drives in drilling have all failed thus far or were not introduced at all; consequently there is no quality in drilling. Drilling goes crooked and breakdowns follow.

Of the new regions at Emba, producing properties were contoured at Djaksimai for 100 wells, at Shuburkudak for 200 wells, but no operations have as yet materialized. About six months ago a well drilled at Shubarkuduk opened a prolific horizon but no tests have been made as yet. Similar wells have been drilled with like results at Iskin in the east, as well as in the west, but the operators have likewise failed to test the layers. At Kulsari of Emba seven oil-bearing layers were discovered during 1936. Three wells were drilled of which one was conserved and the others have been awaiting testing over a period of many months. The operators seem to be more interested in fulfilling the plan for distance drilled than completing wells for production. Another region of Emba (Dsenhilda) was recommended for immediate operations but instead operations were undertaken at Narmundanak. Even here, after drilling one well an oil layer was discovered but its testing has been delayed.

The editorial sums up with a conclusion that the preparation of new oil lands at Emba proceeds slowly, due to the refusal of operators to apply new methods recommended for exploration and prospecting. These new methods imply practical efficiency and initiative.

Emba has failed to live up to plans in 1936. It has shown arrears in production to the extent of 1,260,000 bbl. of crude, due mainly to excessive numbers of idle wells. It appears to be extremely difficult to introduce American methods of operation and American field practice at Emba.

Soviet refining operations are evidently forging ahead due to a number of new refineries erected and to considerable improvements effected in operation. The refiners have pledged themselves to obtain 12,708,000 tons of light products in 1937, which is 2,400,000 tons more than in 1936. They have thus agreed to exceed the plan by 480,000 tons and in addition save 471,000 tons of losses.

At a reception given by S. Ordzonikidze, Commissar for Soviet Heavy Industries, to a delegation of Stakhanov operators together with engineers and their wives, a discussion ensued regarding who was responsible for carrying out pledges given to fulfill and to exceed the plans for 1936. The oil operators pointed to the fact that while the plan for crude production in 1936 was not fulfilled, they have, nevertheless, exceeded the plan in refining operations and have delivered 360,000 tons of oil products over and above plan. New promises and new pledges were made by the refiners for 1937 operations, which are to cover not only plan fulfillment or excesses of the plan in refining operations, but every step will be taken to have the oil producers live up to plan for 1937 in production of crude.

Emphasis was given to the fact that the country has all the reserves and objective possibilities necessary to fulfill the plan, but that unfortunately production of crude is nevertheless in arrears. Owing to production arrears many a Soviet refinery has had to be shut down or operate at a percentage of its capacity, because of lack of crude for full operation. The process of development of new oil lands is a slow process in Soviet Russia and this hampers not only the development of the Soviet oil industry but the Soviet National Economy as well.

It was further pointed out at this meeting that Maikop has delayed the development of the prospective oil fields at Asphalt mountain and at Kuratepe, which is directly responsible for non-delivery of at least 2,000,000 bbl. of Maikop crude to Grozni refineries in 1936. Slow development of Dagneft is causing an-

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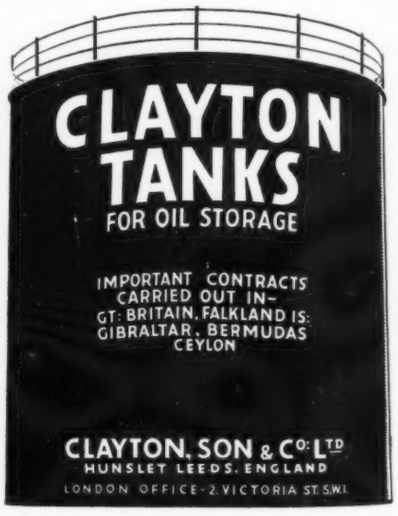

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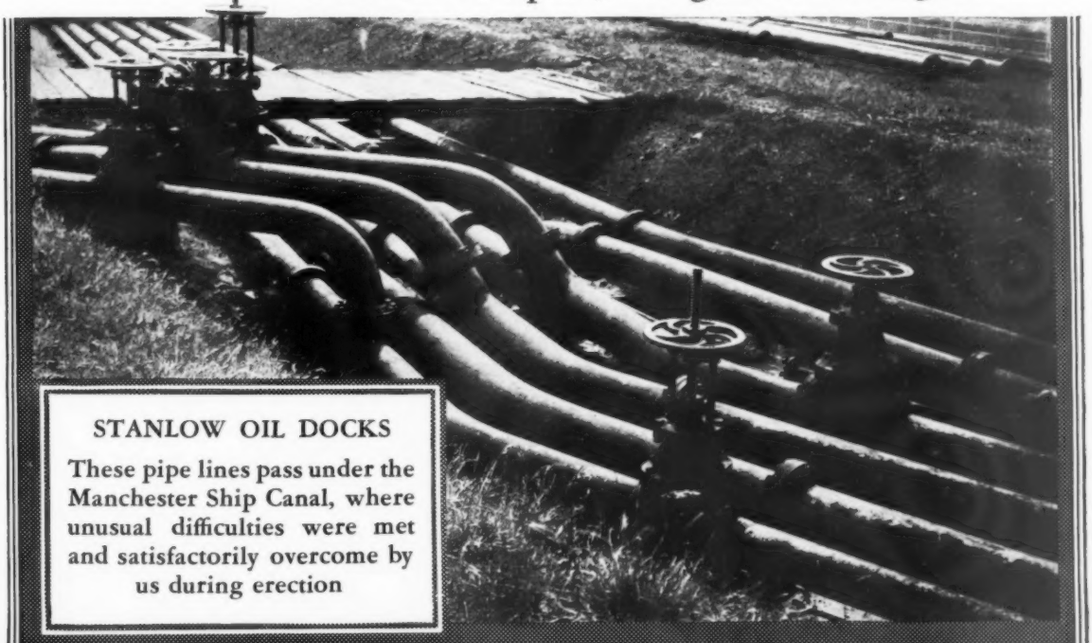

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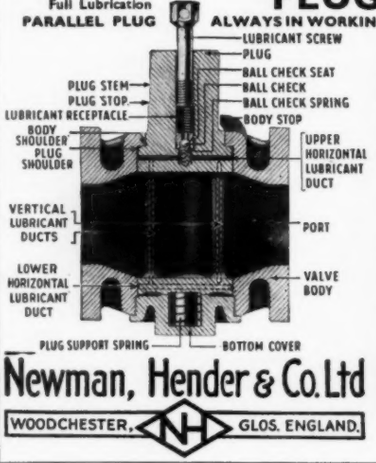

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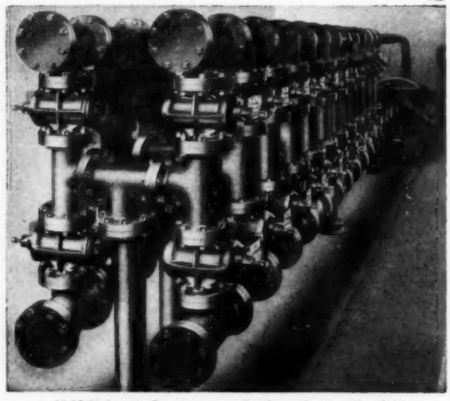

N-M Valves in Service on an Oil Distribution Manifold

other loss of about 7,000 bbl. of crude per day for runs to stills at Grozni. Similar conditions exist also at Emba, upon which crude the Orsk refinery depends, the arrears of crude deliveries from Emba in 1936 being 2,600,000 bbl. These shortcomings which have been so prominent during 1936 operations have not yet been eliminated; they still exist and are even being aggravated at present. Crude production arrears owing to slow tempo of new developments are to be noted at Baku at Kerger, Molotov, Asisvekov, and other properties; at Grozni at Molgabek and Dagneft; at Bashkiria —and, in fact, at all other Soviet oil regions. Here S. Ordzonikidze asked pathetically whether Soviet oil operators are aware of the losses incurred by the U.S.S.R. each year due to low quality of oil products delivered to agriculture and other national consumers. Such losses are enormous and cause a shortage of supplies. It is evident, then, that the oil operators are doing little to fight for oil, for quality, or against high losses of light fractions of the crude.

Mr. Barinov, head of Glavneft, who was also present at this reception, pointed out the vast needs of the Socialist country for oil and reiterated that the country possesses all the potentialities necessary to satisfy demands.

Soviet Trade

ACCORDING to an agreement made between Japan and the U.S.S.R. at the time of the sale of the Chinese-Eastern Railway, the Soviets were to receive part payment (93,300,000 Yen) in trade. (1 Yen=1.443 Rbl.) Of this amount, over 60,000,000 Yen have already been paid the Soviets by Japan as follows:

Equipment (especially manufactured for U.S.S.R.)	11,000,000 Yen
Cables and Copper Wire	8,000,000 Yen
Soya Beans	7,000,000 Yen
Wool, Silk and Cotton Fabrics	5,800,000 Yen
Tea	4,500,000 Yen
Nets and Fishing Tackle	3,800,000 Yen
Base Metals	3,500,000 Yen
Cement	3,000,000 Yen
Ships and Sea-craft	3,000,000 Yen
Fats	2,700,000 Yen

The balance of the payments due in trade are to be made by March, 1938.

Total Soviet trade during 1936 amounted to Rbl. 2,712,000,000, of which Rbl. 1,359,000,000 were exports and Rbl. 1,353,000,000 were imports, leaving a favorable balance of Rbl. 6,000,000. Soviet exports consisted of 75.1 percent industrial products and 24.9 percent agricultural products.

Among the major countries figuring in trade with Soviet Russia, England ranks first with a total trade turn-over (exports to and imports from) of Rbl. 557,800,000. Germany is second with Rbl. 428,800,000 and the United States third with a total turn-over of Rbl. 339,100,000.

Soviet imports in 1936 were 89.1 percent industrial goods and 10.9 percent consumer's goods. Soviet Russia has increased its 1936 imports over 1935 as follows: Machinery and appliances by Rbl. 246,300,000; electrical machinery and parts by Rbl. 39,300,000; nonferrous metal by Rbl. 38,400,000; and precision instruments by Rbl. 12,900,000.

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